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INITIATING A NATIONAL EFFORT TO IMPROVE SOLID WASTE MANAGEMENT

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Rockville, Maryland

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Initiating a National Effort to Improve Solid Waste Management

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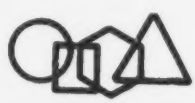
Initiating a National Effort to Improve Solid Waste Management

A comprehensive chronicle (SW-14)
of activities and accomplishments in solid waste management
within
the U.S. Department of Health, Education, and Welfare
under authority of the
Solid Waste Disposal Act of 1965



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FOREWORD

At a time of growing national commitment to restore the quality of our environment, it is important to understand the efforts already made in a categorical program that has been concerned with what has been called the "third pollution."

With the passage of the Solid Waste Disposal Act in 1965 and the establishment of implementing regulations, the Department of Health, Education, and Welfare (DHEW) assumed major responsibilities for improving solid waste management practices in the United States.[1,2]

This document is a report on accomplishments made by the Department in executing its responsibilities under the Act. It is designed to be used in conjunction with the seven companion summary publications that present the complete story of staff, grant, and contract projects, describing objectives, details of funding, and progress on each project.[3-9]

Throughout the report the federal solid wastes program is referred to by the final appelation it held during the latter part of its five years under DHEW,--The Bureau of Solid Waste Management.

--RICHARD D. VAUGHAN
Deputy Assistant Administrator
for Solid Waste Management

---

[1]The Solid Waste Disposal Act; Title II of Public Law 89-272, 89th Cong. S.306, October 20, 1965. Washington, U.S. Government Printing Office, 1966. 5 p.

[2]Grants for solid waste disposal projects. Federal Register, 31(61):5180-5183, Mar. 30, 1966. Reprinted as amended, June 8, 1967. Reprinted, Washington, U.S. Government Printing Office, 1968. 4 p.

[3]Bayless, T. B., comp. Publications of the Federal solid waste management program, 1951--1970. Public Health Service Publication No. 2112. Washington, U.S. Government Printing Office. (In press.)

[4]Toftner, R. O., D. D. Swavely, W. T. Dehn, and B. L. Sweeney, comps. State solid waste planning grants, agencies, and progress--1970; report of activities through June 30, 1970. Public Health Service Publication No. 2031. Washington, U.S. Government Printing Office, 1971. 26 p.

[5]Lefke, L. W., A. G. Keene, R. A. Chapman, and H. Johnson, comps. Summaries of solid wastes research and training grants--1970. Public Health Service Publication No. 1596. Washington, U.S. Government Printing Office. (In press.)

[6]Breidenbach, A. W., comp. Summaries of solid waste intramural research and development projects. Washington, U.S. Government Printing Office, 1971. 24 p.

[7]Sponagle, C. E. Summaries; solid wastes demonstration grant projects--1969. Public Health Service Publication No. 1821. Washington, U.S. Government Printing Office, 1969. 175 p.

[8]Sponagle, C. E. Solid wastes demonstration grant abstracts; grants awarded January 1--June 30, 1969. Cincinnati , U.S. Department of Health, Education, and Welfare, 1969. 47 p.

[9]Clemons, C. A. and R. J. Black. Summaries of solid wastes program contracts, July 1, 1965--June 30, 1968. Public Health Service Publication No. 1897. Washington, U.S. Government Printing Office, 1969. 46 p. Supplement (insert), July 1, 1968--June 30, 1970. 38 p.

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INITIATING A NATIONAL EFFORT TO IMPROVE SOLID WASTE MANAGEMENT

The population of the United States is expected to double within the lifetimes of most of today's citizens, doubling also the demands upon the unchanging air, water, and land resources of our country.

The 1960's ended with a population of over 200 million, a preeminent industrial complex, a vast agricultural industry, and an individual affluence without precedent. The environmental effects of these social phenomena are evident already in air and water pollution, urban and rural blight.

The solid wastes being generated from individuals and communities now exceed 360 million tons a year, only half of which is collected. Agricultural solid wastes are estimated at 2 billion tons a year; mineral wastes add another billion tons each year. As the Nation enters the 1970's it is generating over 3.3 billion tons of solid wastes annually. Within the next 30 years this outpouring of waste material could more than double, as the population is predicted to double.

Space for waste is not limitless. Neither, with such an expansion of population as is anticipated, can we continue to afford the economic loss from profligate discard of used material, much less the increased health hazard to our people from polluted air, water, and land. A substantial portion of our Gross National Product is being junked each year. Billions of tons of material produced by human labor are being

expended as waste without reclamation. The economic loss is compounded by the cost of solid waste management: the collection, transportation, and processing or storage of waste is already the third greatest financial burden of local governments in the Nation, exceeded only by education and road construction and maintenance. This waste is matter, indestructible, and must remain in our environment as gases, liquids, or solids, whether used or unused. Such is the nature of the problem.

In past years, wastes were disposed of in the seemingly limitless reservoirs of air, water, and land. Only recently have we realized that these natural reservoirs are not limitless. Our littered streets, bulging dumps, polluted rivers and dying lakes, the choking air of our cities, and the offal on our beaches testify to decades of neglect and the limits of the environment, which can no longer accommodate the vast and increasing waste products of our society.

This report addresses the specific problem of solid waste management. As defined in the Solid Waste Disposal Act, solid waste is garbage, refuse, and other discarded solid materials, including those resulting from industrial, commercial and agricultural operations, and from community activities. Solid waste does not include solids in domestic sewage or other water resource pollutants such as silt, irrigation return flows, or industrial waste water.

The problem of solid waste disposal is interrelated with those of air and water pollution, each having its own environmental peculiarities. The differences stem principally from the fact that water and air are natural transport systems, whether polluted or unpolluted, whereas

solid wastes require transportation devised by man. Water and air also have a natural cleansing or assimilative capacity; until this capacity is exceeded, they are generally capable of self-renewal. In contrast to this, solid wastes discharged upon the land do not disperse and mingle with the soil except to a very minor degree.

These factors present special problems to solid waste management. Disposition of solids from their original site to processing, storage, or discharge to the environment is primarily mechanical. Processing and discharge are limited by the related problems of air and water pollution. Incineration, grinding, the use of water for either transportation of solids or as solid waste sinks, impinge upon the concurrent attempts to purify the air and water environments. On the other hand, the elimination of impurities from air or water at the source of pollution commonly results in the generation of solid wastes by separation, drying, or compaction, which in turn require disposal. Measures to reduce pollution, or dispose of waste material, must therefore be taken with full consideration of the effect upon the overall environment--air, water, and land.

The intent of the Congress, as reflected in the Solid Waste Disposal Act of 1965, typifies one of the peculiarities of solid waste disposal: it cannot be regulated on a national level in the sense that air and water pollution can be regulated. There is no medium such as air or water that naturally carries solid waste across political boundaries, affecting the people at large. Most solid wastes are deposited on land locally and their disposition remains a local problem. Nevertheless, the people at large are affected in other ways.

The problem is concentrated in densely populated urban areas. Entire neighborhoods are being degenerated, blighting the inner cities and reducing local revenues to such an extent that State or Federal assistance is required to prevent financial chaos.

Refuse storage, collection, transportation, and processing directly and intimately affect some 80 percent of the population.

The costs of waste handling, already severe, are rising.

The loss of billions of tons of material to unreclaimed waste each year indirectly affects the entire citizenry.

The aesthetic and real values of areas with increasing population are being degraded by inadequately effected solid waste disposal.

It was apparent to the Congress that the primary contribution to be made by the Federal Government was assistance to State and local governments and interstate agencies, guided by the overall interests of the Nation. This assistance is rendered in the form of research and development at the national level, and technical and financial assistance for the planning, development, and conduct of solid waste disposal programs at the State, local, and interstate levels.

The results of the Solid Waste Disposal Act have been: (1) the dissemination of technical, operational, and management information; (2) the encouragement and support of research and development on equipment and systems; (3) the demonstration of improved solid waste handling systems; (4) and the development of funding, planning procedures, and personnel training programs.

These activities have been nonregulatory in nature but are intended to have deep and lasting economic and societal effects.

The major economic significance of the solid waste management problem--its overall cost to the Nation--has been indicated above. There are other economic considerations.

The potential for recovery of materials from solid wastes has been exploited to only a small degree, notably in steel and copper. These mineral fractions represent a minor part of the 200 million tons of solid waste discarded and unreclaimed each year. Such wastes are a major national resource, and their return to economical reuse must somehow become a common practice as solid waste increases in the years of the near future.

There is also an unrealized potential in the reduction of costs through increased efficiency in the handling, transportation, processing, and disposal of solid wastes. Mechanization, with its reduced demands for human labor, improvement of personnel skills through manpower development programs, and reduced accident rates in the waste disposal processes, are under study and experimentation with the objective of long-term cost reduction.

The cost of the Nation in human physiological disorders that result from inadequate disposal of solid waste cannot be determined. It is known that conditions favoring insect and rodent disease vectors are enhanced by undisposed waste, and that polluted air and water contribute to human disease. Considering the large number of workers in the areas of waste collection, processing, and disposal, and considering the

hazardous nature of their occupations, their lack of training, and exposure of extremes of weather, the high cost in deaths, debilitation, and lost man-hours through illness is predictable.

Since one of the current problems of solid waste disposal relates to modes of transportation to processing sites or repository, an adequate solution might also be applicable to the commercial hauling of bulk materials (such as coal and ore).

The problems of solid waste management compel the development of techniques and systems vastly more sophisticated than those now in common use. The ultimate effect of such developments is no more predictable than the side benefits from the space program. What can be clearly assessed, however, is that the urban, industrial, and agricultural activities of the population have resulted thus far in a degradation of the overall environment of the United States, and that this trend must be reversed.

Only in the last decade have serious thought and effort been addressed nationally to the problems of waste disposal. During that time, the basic philosophy has changed. From an initial concentration on pollution control, and the attempt to regulate the flow of waste from its sources, a realization has grown that our real concern is for the overall quality of the environment. Broad objectives of clean air, pure water, and a higher quality of life in our country are those receiving popular support and dominating public policy through elected representatives and officials. The American people are not satisfied to live with polluted air or water, or amidst their own solid wastes.

And at best, the production of waste material can only be reduced by regulation at the Federal or State level.

We have found that the immediate practical solution to solid waste problems is in physical procedures: collection methods, transportation, processing, recycling into the economy, or sequestering unusable material into permanent storage. We have recognized that such efforts must be efficient, economical, not injurious to either public health or the ecology, and aesthetically satisfactory to our citizens.

The Federal Government has devoted its resources to such functions as can assist in realizing these objectives. The Federal efforts, solutions, and continuing problems of the past five years are set forth in the following pages.

II

HISTORY OF FEDERAL GOVERNMENT ACTIVITIES IN SOLID WASTE MANAGEMENT

Interest in solid waste disposal as a national problem was evident as early as the 19th century. One of the initial efforts was to document the existing system of garbage disposal in 1887. During that year, the American Public Health Association established a committee to study the problem and received its report on the destruction of organic refuse by fire the following year.[10] In 1894, a similar committee undertook a study of the collection and disposal of waste matter and completed a report in 1897.

Almost a generation later, a classic and comprehensive study was made by Randolph Hering and Samuel A. Greeley. Published in 1921, *Collection and Disposal of Municipal Refuse* is of continued interest today.[11] Hering and Greeley estimated the waste production of 33 cities, varying in population between 25,000 and 4,250,000, with a total population of 17,750,000 included in the study. The investigators computed an annual average waste production per capita of 183 pounds

[10]Kilvington, S. S. Garbage crematories and the destruction of organic matter by fire. Minneapolis, Harrison and Smith, 1888. [8 p.]

[11]Hering, R., and S. A. Greeley. Collection and disposal of municipal refuse. New York, McGraw-Hill Book Company, 1921. 653 p.

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garbage and 770 pounds ashes and rubbish, or 953 pounds total. This amounted to 2.58 pounds of refuse per capita per day. The work of Hering and Greeley also established three basic requirements for the satisfactory disposal of solid wastes: (1) absence of danger to public health, (2) minimum distance to the public, (3) minimum expense that will affect a sanitary disposal of all refuse materials.

The Postwar Years

Although these early examples addressed the problems of solid waste disposal from a national, rather than local, viewpoint, they were neither initiated nor sponsored by the Federal Government. It was not until World War II and its aftermath that the problem of waste disposal became sufficiently severe at the local level to incite action by the executive, and subsequently the legislative, branches of the Federal Government. The enormously increased productivity of the war years was carried into the postwar period and continued. The population exploded into initial and secondary "baby booms." The affluence of society accelerated the generation of solid waste. Twenty years after the end of World War II, air and water pollution, junked vehicles and appliances, used but persistent detergents and pesticides, had become problems of the people at large and, as a result, problems of their Nation's government.

Prior to 1966, there were solid-waste-related activities within the Department of Health, Education, and Welfare; these were conducted in a small operation within the Environmental Engineering and Food Protection

Division of the Public Health Service. A staff of from two to five people conducted studies in the areas of sanitary landfill and composting operations. The staff also provided limited technical assistance, guidance, and consultation on solid waste handling and disposal to State and local government agencies, professional organizations, and individuals.

In addition, under the Public Health Service Act, research grants at an annual level of about $200 thousand were awarded for the development of a data base in the area of solid waste management. The Public Health Service, in cooperation with the American Public Works Association (APWA), sponsored a national conference on solid wastes research in December 1963.[12] Assistance was provided the APWA in preparing two manuals, *Municipal Refuse Disposal* and *Refuse Collection Practices*, both of which still serve as major guidelines for the design and evaluation of refuse collection and disposal systems by public works and health officials.[13,14] The Public Health Service, during the early 1960's, also participated with the APWA and State and local agencies in training programs on solid waste disposal.

The Solid Waste Disposal Act

In a 1965 message to Congress, the President stated:

> Continuing technological progress and improvement

[12]Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 1963, University of Chicago Center for Continuing Education. Special Report No. 29. American Public Works Association, 1964. 228 p.

[13]American Public Works Association. Municipal refuse disposal. 3d ed. Chicago, Public Administration Service, 1970. 538 p.

[14]American Public Works Association. Refuse collection practice. 3d ed. Chicago, Public Administration Service, 1966. 525 p.

> in methods of manufacture, packaging, and marketing of consumer products has resulted in an ever-mounting increase of discarded material. We need to seek better solutions to the disposal of these wastes.

In the same message, the President recommended legislation to:

> Assist the States in developing comprehensive programs for some form of solid waste disposal. Provide for research and demonstration projects leading to more effective methods for disposing of or salvaging solid wastes.[15]

The Congress recognized the increased threat to the health and well-being of its constitutents by the mounting quantities of solid wastes generated by all segments of the society. Too, it recognized the rapidly increasing costs of collection and disposal, the depletion of some of the country's natural resources, and the very real threat to the quality of man's environment. After consideration of the Nation's solid waste management problem, the congress formalized its findings as follows.

The Congress finds--

> (1) that the continuing technological progress and improvement in methods of manufacture, packaging, and marketing of consumer products has resulted in an ever-mounting increase, and in a change in the characteristics, of the mass of material discarded by the purchaser of such products;
>
> (2) that the economic and population growth of our Nation, and the improvements in the standard of living enjoyed by our population, have required increased industrial production to meet our needs, and have made necessary the demolition of old buildings, the construction of new buildings, and

[15]Special message to the congress on conservation and restoration of natural beauty, February 8, 1965. In Public papers of the presidents of the United States; Lyndon B. Johnson. v. 1. Washington, U.S. Government Printing Office, 1966. p. 163.

the provision of highways and other avenues of transportation, which, together with related industrial, commercial, and agricultural operations, have resulted in a rising tide of scrap, discarded, and waste materials;

(3) that the continuing concentration of our population in expanding metropolitan and other urban areas has presented these communities with serious financial, management, intergovernmental, and technical problems in the disposal of solid wastes resulting from the industrial, commercial, domestic, and other activities carried on in such areas;

(4) that inefficient and improper methods of disposal of solid wastes result in scenic blights, create serious hazards to the public health, including pollution of air and water resources, accident hazards, and increase in rodent and insect vectors of disease, have an adverse effect on land values, create public nuisances, otherwise interfere with community life and development;

(5) that the failure or inability to salvage and reuse such materials economically results in the unnecessary waste and depletion of our natural resources; and

(6) that while the collection and disposal of solid wastes should continue to be primarily the function of State, regional, and local agencies, the problems of waste disposal as set forth above have become a matter national in scope and in concern and necessitate Federal action through financial and technical assistance and leadership in the development, demonstration, and application of new and improved methods and processes to reduce the amount of waste and unsalvageable materials and to provide for proper and economical solid-waste disposal practices.

To cope with these threats Congress passed the Solid Waste Disposal Act of 1965 (Public Law 89-272) and amended it in 1968 (PL 90-574) principally to extend the operations of the original Act.[16]

[16]Solid Waste Disposal Act Amendment of 1968; report of the Committee on Public Works, U.S. Senate, to accompany S.3201, 90th Cong., 2d sess., Report No. 1447. Washington, U.S. Government Printing Office, 1968. 33 p.

The two basic purposes for the legislation were stated in the 1965 Act:

> (1) To initiate and accelerate a national research and development program for new and improved methods of proper and economic solid-waste disposal, including studies directed towards the conservation of natural resources by reducing the amount of wastes and unsalvageable materials and by recovery and utilization of potential resources in solid wastes; and
>
> (2) To provide technical and financial assistance to State and local governments and interstate agencies in the planning, development, and conduct of solid-waste disposal programs.[17]

There were four distinct products from the passage of this Act, each furthering the expressed purposes of the Congress:

(1) The problem of solid waste disposal was identified as a national as well as a local issue.

(2) The implication was made that the overall quality of the environment, rather than the more mechanical and restrictive problems of pollution control and waste disposal, was the central objective.

(3) Increased funds were authorized for what had hitherto been an essentially low-budget operation.

(4) The problem, as identified, and the resources allocated, required an organization capable of fulfilling these research responsibilities.

The Solid Waste Disposal Act divided responsibility between two Federal Departments: the Department of Health, Education, and Welfare

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[17] Solid Waste Disposal Act; Title II of Public Law 89-272, 89th Cong. S.306 October 20, 1965. Washington, U.S. Government Printing Office, 1966. 5 p.

was given the principal responsibility, and the Department of the Interior was made responsible for problems associated with handling and disposing of those solid wastes resulting from processing fossil fuels and minerals.

The Congress authorized the appropriation of $79.95 million for the five fiscal years from 1966 to 1970, to be provided the Department of Health, Education, and Welfare (DHEW) for carrying out the commitment in solid waste management at the national level (Figure 1). For the same period, the Department of Interior was separately authorized $44.55 million to address the problems of waste disposal resulting from mining and the processing of minerals and fossil fuels.

The Act authorized specific action in six areas of need: (1) grant support for local and State projects to demonstrate new and improved waste disposal technology; (2) grant support for the development of area-wide solid waste management systems to end fragmentation of responsibilities among small communities; (3) grant support for the development of State and interstate plans for meeting solid waste handling needs; (4) research, both direct and grant supported, to establish the basis for new approaches to solid waste handling; (5) training programs, both direct and grant supported, to alleviate critical shortages of trained personnel; (6) cooperation with public and private agencies, institutions, and organizations, and with any industries involved, in the preparation and the conduct of activities.[18]

[18]Solid Waste Disposal Act.

CONGRESSIONAL APPROPRIATIONS AUTHORIZED TO DHEW
UNDER THE SOLID WASTE DISPOSAL ACT

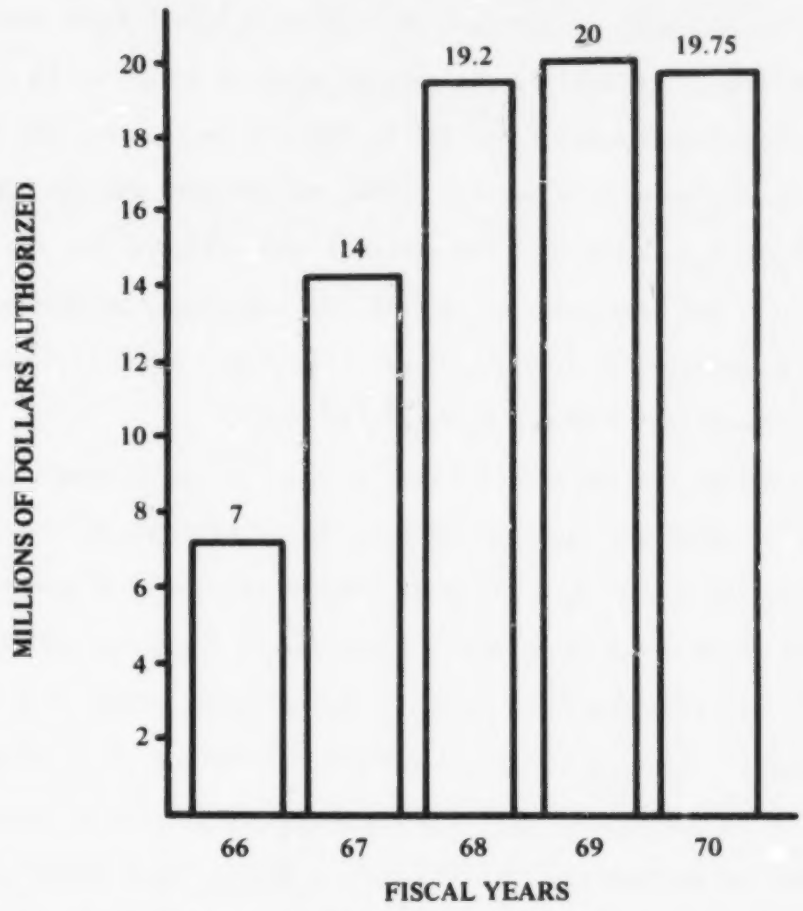

Figure 1. Under the Solid Waste Disposal Act the congress authorized appropriations at almost $80 million to the Department of Health, Education, and Welfare to begin the national effort toward economical and effective management of the 3.3 billion tons generated annually in the United States.

Organization under DHEW

Office of Solid Wastes. Passage of the Act on October 20, 1965, resulted in the establishment of an Office of Solid Wastes within the Public Health Service of the Department of Health, Education, and Welfare.

The authorities and responsibilities conferred on the Secretary of Health, Education, and Welfare were delegated to the Surgeon General of the Public Health Service and, in turn, by him to the Chief, Office of Solid Wastes. Four million dollars of supplemental funds were appropriated by the Congress and apportioned to the Office of Solid Wastes on January 25, 1966, by which time marked progress had already been made in staff recruitment and administrative development for the new program.

The Office of Solid Wastes made the pioneer efforts under the new Act during its first year. Operations and the allocation of resources were generally divided between two broad functions: the apportionment of grants; and the conduct of direct operations by the Federal Government. Grant support was utilized to implement action in five of the six categories of need assessed by the Congress (see above), while direct action was also taken in the areas of research, training, and technical assistance. This basic framework for operations has been continued with only minor variation through the several reorganizations of DHEW's solid wastes program effected since the establishment of the Office of Solid Wastes on December 3, 1965.

Solid Wastes Program. In January 1967, the Office of Solid Wastes was designated as the Solid Wastes Program within the new National Center for Urban and Industrial Health with headquarters at Cincinnati, Ohio.

For the next two years, the Program continued to effect the responsibilities of the Department of Health, Education, and Welfare for solid waste management, under the direction and guidance of the Surgeon General. As planned in the original Solid Waste Disposal Act, these two years were a period of increasing activity, supported by public funds that reached the present level of nearly $20 million a year.

Bureau of Solid Waste Management. In July 1968, the Public Health Service was reorganized into three major health units: Consumer Protection and Environmental Health Service, Health Services and Mental Health Administration, and National Institutes of Health. The first of these was formed largely from the Food and Drug Administration and the former Bureau of Disease Prevention and Environmental Control of the Health Services and Mental Health Administration.

On December 20, 1968, announcement was made in the Federal Register, (vol. 33, No. 247) of the organization of the Consumer Protection and Environmental Health Service, which consisted of the Food and Drug Administration, the National Air Pollution Control Administration, and the Environmental Control Administration. The latter was composed largely of two previously existing Centers: the National Center for Radiological Health and the National Center for Urban and Industrial Health. The former Solid Wastes Program, within the latter organization, was reorganized in January 1969 into the Bureau of Solid Waste Management, one of five bureaus in the Environmental Control Administration. In December 1969, the Consumer Protection and Environmental Health Service was restructured and renamed the Environmental Health Service, with

the Food and Drug Administration being placed elsewhere organizationally in the Department. The reorganization, however, did not affect this Bureau.

The Bureau of Solid Waste Management: plans, conducts, and promotes research, investigations, experiments, demonstrations, surveys, and studies relating to the conduct of solid waste programs and development and application of new and improved methods of solid waste storage, collection, and disposal; develops new and improved methods of reducing the amount of solid waste requiring ultimate disposal, through reuse, recycling, and source reduction and provides technical and financial assistance to appropriate agencies and organizations in planning, developing, and conducting a solid waste management program; collects and provides, through publications and special reports, the results and professional analyses of research and technically oriented activities being conducted in the field of solid waste management; encourages cooperative activities in solid waste management by the States and local governments and encourages interstate, intrastate, and regional solid waste planning.[19]

The functions of the three divisions and two offices of the Bureau (Figure 2) are described below.

Division of Demonstration Operations (DDO). The Division of Demonstration Operations plans, develops, conducts, and evaluates through

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[19][Lovell, L. B.] Solid wastes. In Environmental health planning. Public Health Service Publication No. 2120. Washington, U.S. Government Printing Office, 1971. p. 31-36.

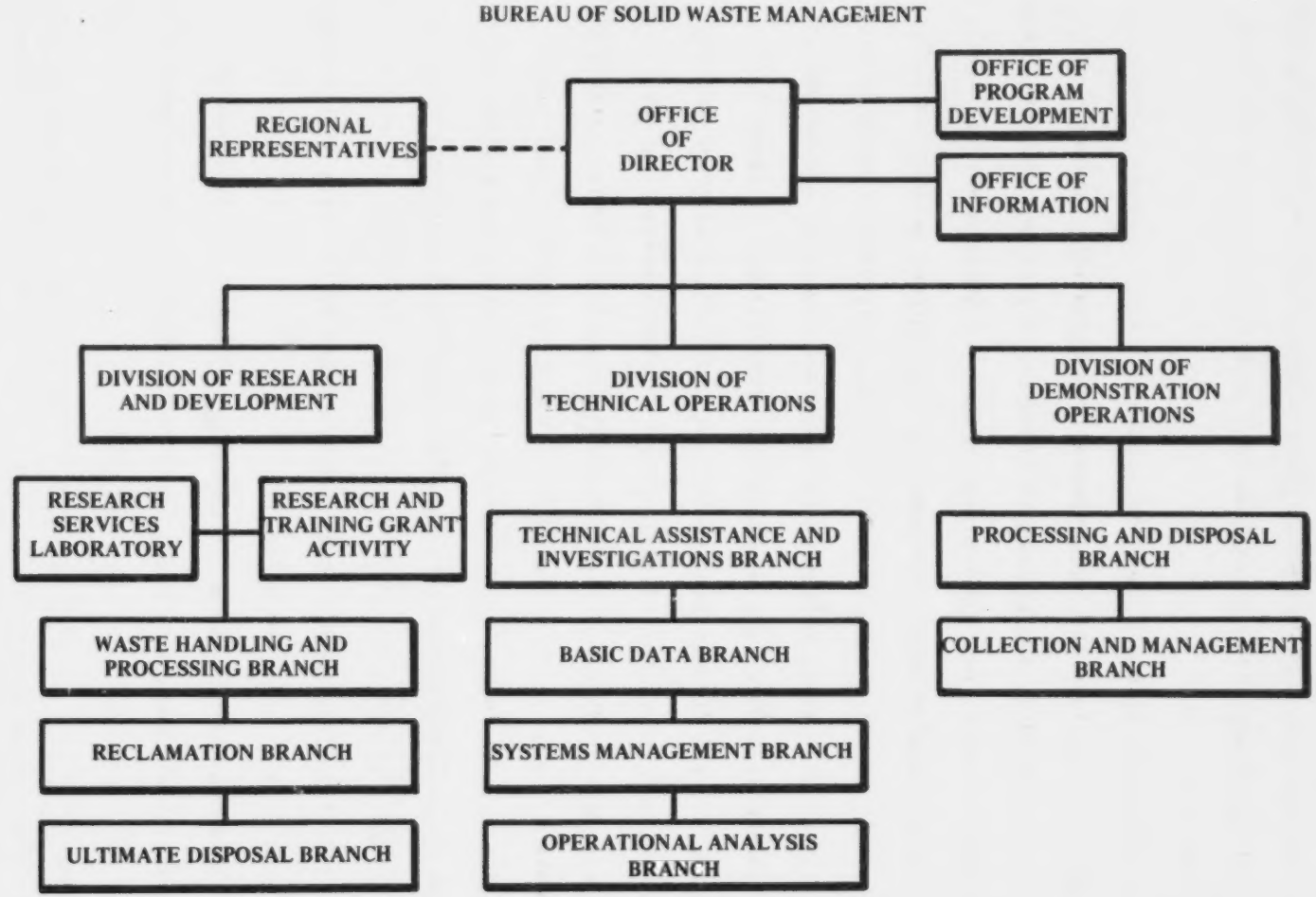

Figure 2. The two offices and three divisions of the Bureau of Solid Waste Management in August 1970.

direct activities, grants, contracts, and demonstrations to encourage the application of new and improved methods, techniques, and equipment for solid waste management.

Division of Research and Development (DR&D). The Division of Research and Development plans, conducts, and evaluates research concerning solid waste systems and systems requirements, and new and improved means of managing as well as reducing the generation of solid waste. This division plans, develops, and conducts municipal-scale development projects to encourage the application of new and improved methods, techniques, and equipment for solid waste management. DR&D manages grants-in-aid programs to combat solid waste problems facing the Nation and develops operations research techniques to the management of solid waste systems and plans, conducts, and evaluates research in the socioeconomic science and its relationship to solid wastes management systems.

Division of Technical Operations (DTO). The Division of Technical Operations encourages and supports the planning, development, and conduct of solid waste management programs through consultation, information, and technical assistance to public and private agencies, organizations, and individuals. DTO provides assistance in the economic, mathematical, and computer sciences related to the interpretation of solid waste technology. This division also manages a program of planning grants to State and interstate agencies and fosters implementation. Another function of DTO is to collect and evaluate basic statistical data on a

national basis relating to solid wastes, investigate specific problems through special studies, and to develop criteria for standards, model ordinances, and regulations.

Office of Program Development. The Office of Program Development assists and advises the Bureau Director in the development, coordination, and assessment of program planning operations; coordinates and develops Bureau planning strategy in accordance with ECA policy; identifies the need for new programs, and develops proposals and mechanisms for their creation; provides liaison with the Office of Program Development, ECA, and provides leadership within the Bureau in the discharging of program planning requirements within ECA guidelines; evaluates program output with respect to plans and funds, administers and implements PPB operations, and incorporates planning data into the budget process; provides Bureau focal point for legislative planning; and conducts internal program analyses and special studies.

Office of Information. The Bureau's Office of Information plans, directs, and coordinates the dissemination of solid waste information to the general and professional public, and staff. Provides necessary services to develop, design, review, edit, print, and distribute Bureau publications resulting from contract, grant, and in-house activities; directs and operates solid waste management information retrieval from the world-wide literature. Develops displays, exhibits, motion picture films, and other visual materials and reviews and coordinates public presentations by staff members of the Bureau.

As of the end of December 1968, there were 180 full-time employees assigned to the Bureau (Table 1).

Certain administrative, programming, training, and fiscal functions are handled centrally by the Environmental Control Administration. The administrative details of research and training grants, for example, are performed in the Office of the ECA Commissioner while the technical overview is the responsibility of the Bureau.

Fiscal Data

The general levels of funding to the Department of Health, Education, and Welfare for solid waste disposal grew from $4.3 million (FY 1966) to $15.2 million (FY 1970) (Table 2). Utilization of funds during the five years has remained relatively constant, proportionally allocated to support of the five broad categories of effort: demonstrations, research, planning, training, and direct operations (Table 3).

The initial year of operations under the Solid Waste Disposal Act (FY 1966) saw a greater emphasis on demonstration and research grants than in subsequent years, with less emphasis on direct operations. Beginning with FY 1967, the employment of funds in the general categories has remained about the same; the major resources supporting demonstration grants and direct operations, with research and planning grants receiving the next greatest emphasis, and training grants remaining at a constant level of 3 percent of the overall budget.

These relatively steady apportionments of the overall funds available do not reflect the expansion actually obtained by the increased

TABLE 1

FULL-TIME EMPLOYEES OF THE BUREAU OF SOLID WASTE MANAGEMENT (DECEMBER 1968)

	Headquarters (Rockville)	Cincinnati	Morgantown	Johnson City	Regions	Outside service training
Office of Director	6	11	-	-	-	6
Regional Representatives	-	-	-	-	18	-
Office of Program Development	-	6	-	-	-	-
Office of Information	1	13	-	-	-	-
Division of Research and Development	2	40	1	5	-	-
Division of Technical Operations	2	51	-	-	-	-
Division of Demonstration Operations	-	18	-	-	-	-
Totals	11	139	1	5	18	6

TABLE 2

BUDGET HISTORY OF THE BUREAU OF SOLID WASTE MANAGEMENT
(Fiscal Years 1966-1971) (in thousands of dollars)

Amounts	Fiscal Years					
	FY 66	FY 67	FY 68	FY 69	FY 70	FY 71
Authorized by Solid Waste Disposal Act	7,000	14,000	19,200	20,000	19,750	-
Requested by DHEW to BoB	6,610	13,377	18,865	20,000	18,300	17,626*
Approved by BoB and requested by DHEW to Congress	6,525	12,369	15,602	17,534	14,872	15,336*
Appropriated by Congress	4,000	12,363	15,602	16,926	15,872*	-
Reserved for reserves by BoB	0	-163	-337	-942	-799*	-
Cutbacks and additions (total)	+334	-8	-1,908	-868	+202*	-
Obligated by BSWM (total)	4,334	12,192	13,357	15,116	15,275*	-

*Includes $1,000,000 increase.

TABLE 3

BUREAU OF SOLID WASTE MANAGEMENT ACTUAL BUDGET OBLIGATIONS
(Fiscal Years 1966-1970)

Categories of effort		Fiscal Years				
		FY 66	FY 67	FY 68	FY 69	FY 70
Grants:	Research	$ 853,000	$ 1,677,000	$ 2,261,000	$ 2,444,000	$ 1,944,000
	Training	150,000	350,000	443,000	486,000	490,000
	Demonstration	1,989,000	5,000,000	4,744,000	5,134,000	4,650,000
	Planning	400,000	997,000	1,467,000	1,858,000	1,500,000
		3,392,000	8,024,000	8,915,000	9,922,000	8,584,000
Direct Operations		942,000	4,168,000	4,442,000	5,194,000	5,691,000
Contracts		(380,630)	(1,295,282)	(1,100,408)	(1,382,583)	(2,600,000)
Total		$4,334,000	$12,192,000	$13,357,000	$15,116,000	$14,275,000

authorizations and appropriations during the 1966-1970 period. Training grants, as an example, remained a fixed 3 percent of the budget throughout the 5-year period; increased authorizations over the same period provided an increase in training grants from $150,000 in FY 1966 to $490,000 for FY 1970. A similar increase in actual, as opposed to proportional, funds occurred in the other major categories of fiscal effort (Table 3).

With the exception of the initial year of operations under the Solid Waste Disposal Act, the proportion of funds budgeted and allocated to direct operations has also remained constant, with an increase of available funds throughout the 5-year period permitting expansion of operations within the overall budget. Separate from the system of grants, the direct operations of what has become the Bureau of Solid Waste Management have involved research, training, and demonstration development as well as technical assistance to State and local governments, associations, and individuals, as a part of its responsibilities. These direct operations had a modest beginning in the remaining months of Fiscal Year 1966, under the newly passed Act that also provided the initial authorization of funds. Commencing with Fiscal Year 1967, research became a multimillion-dollar effort; the in-house and directly-supported training program has grown to almost $500 thousand annually; technical assistance to both governmental and private interests has passed the million-dollar mark; and the development of demonstration installations and techniques has increased to over $750 thousand of expenditure annually.

Conclusion

The history of Federal Government activities in solid waste management under DHEW has been one of innovation, adaptation, and adherence to the expressed and implied intent of Congress. Operations have been in response to both the needs set forth in the Solid Waste Disposal Act and the requirements expressed by State and local governments within the spirit of that Act. The level of $20 million a year anticipated in the original Act was reached in FY 1969 and slightly reduced for the FY 1970 period. Most of the States, 5 interstate agencies, Guam, Puerto Rico, and the District of Columbia, are participating in the national problem of solid waste disposal, through planning grants for State-wide surveys and the development of comprehensive solid waste management systems on a regional basis. The solid waste management functions of the national government are a product of almost five years' experience and uninterrupted effort in a serious and continuing problem area.

III

ACTIVITIES IN SOLID WASTE MANAGEMENT, 1966-1970

Demonstration Operations

One of the three major responsibilities that were assigned to the Office of Solid Wastes in pursuance of the objectives set forth in the Solid Waste Disposal Act of 1965 was the responsibility for encouragement and support of projects to demonstrate new and improved methods of solid waste collection, handling, and disposal. The Act authorized demonstration grants to provide up to two-thirds of the funds necessary for local and State projects to demonstrate new and improved waste-disposal technology. It also authorized the same level of Federal support for the development of area-wide solid waste management systems designed to coordinate waste disposal activities across city and county boundaries, a means of ending the fragmentation of disposal responsibility within an area and increasing the efficiency of disposal operations.

In order to administer the provisions of the Solid Waste Disposal Act of 1965 in the area of demonstration grants, a Demonstration Grants Activities section was created within the Solid Wastes Program. Principal functions of Demonstration Grants Activities included: providing advice about the development of new applications when required; conducting technical review of new applications for demonstration grants to determine the feasibility and value of the proposed project; monitoring funded

grant projects during the lifetime of the grant to evaluate progress and ensure that the appropriate Federal requirements are met by the grantee; reporting research results as such results develop during the lifetime of each grant. The section, now the Division of Demonstration Operations, was responsible for the development of necessary administrative and fiscal procedures for demonstration grant management and supervision.

Objectives of the Demonstration Grant Projects. Two fundamental types of projects exist under the supervision of the Division of Demonstration Operations: projects specifically for demonstration and study-and-investigation projects, which, while they may involve the construction of small laboratory models for testing, do not primarily involve the acquisition or erection of a large physical plant. Each of the projects has a particular purpose, and is intended to reach a defined objective that is one part of the total solid-waste picture.

By June 30, 1969, 102 Federal grants had been made to demonstration projects that fall into the categories defined by the Solid Waste Disposal Act of 1965.[20,21] These categories are:

1. Demonstrations that relate to the development or application of new and improved solid waste disposal methods, devices, or techniques.

2. Study-and-investigation projects concerned with municipal or regional solid waste disposal practices, where such projects may provide solutions for regional or national solid waste disposal problems.

[20]Sponagle. Summaries.

[21]Sponagle. Abstracts.

3. Study-and-investigation projects concerned with municipal or regional solid waste disposal practices, where such projects may lead to a demonstration of improved methods or techniques.

4. Study-and-investigation projects concerned with a particular type of waste, or with a particular solid waste disposal problem, practice, or technique, where the findings of such a study or investigation may be of significant national interest and value.

For a complete description of the funding, objectives, procedures, and progress to date of each demonstration grant awarded by the Bureau of Solid Waste Management, see the current edition of Public Health Service Publication No. 1821, *Solid Wastes Demonstration Grant Projects--1969*, and supplements thereto.[22,23]

Achievements. Section 204 of the Solid Waste Disposal Act of 1965 authorized Federal grants-in-aid intended to encourage demonstrations of new ideas and technologies in the solid waste disposal field where such innovations, while offering the possibility of solutions to particular solid waste problems, might involve considerable risk of failure--risks of such magnitude as to make local government or the authorities of a small community hesitant to assume the financial burden of testing the new idea rather than relying on proven and therefore more predictable, albeit less effective or desirable, methods of dealing with solid wastes. Such demonstration projects serve to facilitate the practical

[22]Sponagle. Summaries.

[23]Sponagle. Abstracts.

application and general acceptance of techniques based on newly-discovered knowledge; they provide for the initial, inevitable costs of adjusting a laboratory project to the demands of full-scale operation in an unpredictable real world; and they provide the only effective way of demonstrating that a new technique or theory can become a practical addition to the armamentarium of the civil engineer. In addition, demonstration projects stimulate public interest and contribute to public acceptance of such new techniques as the sanitary landfill; no amount of explanatory publicity can so effectively demonstrate the difference between a well-engineered sanitary landfill and a conventional open-burning dump, for instance, as can the simple inspection of a sanitary-landfill demonstration project from a passing automobile on a Sunday drive.

Projects have been funded demonstrating new technology in the following broad categories: storage and collection, sanitary landfill and reclamation, incinerators and incineration, composting, rail haul, management of specific wastes, planning for area-wide solid waste management, and equipment evaluation and development.

Storage and Collection. Statistical analysis indicates the approximately 75 to 80 percent of the total cost of solid waste management as presently practiced throughout the United States is related to storage and collection; consequently the application of new and more economical techniques in this area promises to provide the greatest immediate financial benefits.

Sanitary Landfill. One of the questions asked on the form for the 1968 National Survey of Community Solid Waste Practices, for respondents who indicated that they used landfill methods to dispose of solid wastes, was the question "Is this a sanitary landfill?" Fourteen percent of the sites surveyed were judged by the interviewers to be sanitary landfills to the extent that a positive response could be made to this question. The survey form had several other questions, however, which allowed a check to be made on this response, and when those sites where water pollution problems or open-air burning of wastes were reported had been eliminated from the list of sanitary landfills, along with those sites where each day's accumulated refuse and garbage was not compacted and covered with earth by the end of the day, it was found that less than half those respondents who considered their operations to be sanitary landfills actually met the rather modest engineering requirements considered, by those familiar with solid waste management, to be minimum standards for sanitary landfills.[24,25]

Clearly, there is a major problem in public education to be dealt with here. If even the officials who are in charge of the Nation's solid waste disposal facilities on the local level cannot reliably judge whether

[24]Muhich, A. J., A. J. Klee, and P. W. Britton. Preliminary data analysis; 1968 national survey of community solid waste practices. Public Health Service Publication No. 1867. Washington, U.S. Government Printing Office, 1968. 483 p.

[25]Black, R. J., A. J. Muhich, A. J. Klee, H. L. Hickman, Jr., and R. D. Vaughan. The national solid wastes survey; an interim report. [Cincinnati], U.S. Department of Health, Education, and Welfare, [1968]. 53 p.

or not the sanitary landfill standards, as they are generally understood, can be met by the refuse- and garbage-disposal operations directly under their jurisdiction, then the public at large can hardly be held culpable for failing to realize that the disposal of solid wastes can be accomplished without causing blight, ugliness, and vermin to proliferate. And until it is generally known that there are solutions to the problems of pollution and waste that have been raised by the growth of our urban centers and the increase of our population, there can hardly be the sort of general support that it will take to put these solutions into practice.

It is one of the real strengths of the demonstration grant projects program that the projects contribute to the solution of this public-education problem. Demonstration grants for projects in the area of land reclamation and sanitary landfill projects, in addition to the specific information they provide as to the feasibility and the operating parameters of particular types of landfills, also serve to acquaint the general public in the most direct and effective fashion with the results that can be obtained by the application of new techniques in the area of sanitary landfill.

Incinerators and Incineration. Of the approximately 300 large community incinerator installations in the United States, 70 percent are without adequate air-pollution control devices. It is common practice to release incinerator residues and quench waters into the environment without treatment and without control of the long-term effects. The 8 percent of solid waste now being dealt with by incineration

may have to be increased, as time passes, to deal adequately with the growth of urban areas where land for landfill is not available on an economically competitive basis. All of these considerations point up the importance of research and development in the area of incinerator technology.

Under the demonstration grants activity of the solid wastes program, a number of grants have been made to advance the technology of incinerators and at least one interim report has been published by the Bureau.[26]

Composting. It is difficult to keep all matters of public concern in the public eye continuously, and at the present time air pollution and water are receiving much publicity. Nor are these problems anything less than urgent. But other threats to the biosphere also exist, and must be given due consideration by the public and by solid waste management authorities. The exhaustion of the earth's natural deposits of coal, oil, metal ores, and other substances vitally necessary to the maintenance of, not only civilization as we know it, but also the viability of life on earth, has been a source of concern for many years. In the long run, it is as important to prevent the loss of irreplaceable soil-fertilizing elements such as phosphorous from the land as it is to prevent the poisoning of our atmosphere and our oceans. One of the ways in which the cycle of elements can be maintained is through the use of

[26]Kaiser, E. R. Evaluation of the Melt-Zit high-temperature incinerator; operation test report, August 1968. Cincinnati, U.S. Department of Health, Education, and Welfare, 1969. [116 p.]

composting--the treatment of solid wastes so that they can be used as soil conditioners and be returned to the earth. Thus, the minerals that are removed by growing plants would be replaced in the soil rather than irretrievably lost in the oceanic abyss.

Only two demonstration grant projects have been related to composting as a method of solid waste disposal, but this is not in any way a minimization of the importance or the potential of this approach to managing solid waste. In coordination with research and development being conducted in connection with the problem of water pollution, composting may provide solutions to problems that cannot be dealt with in any other way.

The first of these projects, demonstrating the reliability, suitability, economy, feasibility, and nuisance-free operation of a high-rate mechanical composting system when used to dispose of the refuse from a medium-sized community, has been brought to completion. This demonstration was carried out by the Gainesville Municipal Waste Conversion Authority of Gainesville, Florida. It consisted of the construction of a compost plant designed to process 20 tons of refuse per hour, using municipal refuse from the city of Gainesville and Alachua County in combination with either raw or digested sewage sludge. Records were kept of the amounts of refuse and sludge processed, of the amounts of compost produced, and of the noncompostable material salvaged from the municipal refuse input. A complete cost analysis was made, covering operating and maintenance costs of the equipment. The efficiency of the equipment was evaluated, operating characteristics and maintenance requirements were determined,

and the health of compost-plant employees was monitored to determine if occupational hazards existed. Analyses were made of the biological, chemical, physical, and bacteriological nature of the compost in the raw, partially-digested, and finished states, and the final product was compared with commercially-available organic fertilizers. The project was completed by the end of 1968, and the results were published by the Bureau of Solid Waste Management.[27]

Rail Haul. Two study-and-investigation project grants have been made to advance the evaluation of the costs and the benefits to be expected of the use of railroads to transport solid wastes from densely populated urban areas to areas where sanitary landfill is not uneconomic due to high land cost. The groundwork has been firmly established, unpromising alternatives have been identified and discarded, and the study is concentrating on three major assumptions: that transfer stations will collect and process the waste in the generating communities, that rail facilities will be used--perhaps with containerization of some types of wastes--to move the processed waste to remote sites, and that final disposal of the wastes will be accomplished by use of sanitary landfill techniques at carefully prepared sites.

Studies of the transportation of refuse by rail show that rail transport should be feasible, under current conditions, over distances of from 10 to 400 miles. Design of special railroad cars to facilitate

[27]Gainesville Municipal Waste Conversion Authority, Inc. Gainesville compost plant; an interim report. Cincinnati, U.S. Department of Health, Education, and Welfare, 1969. [345 p.]

the transfer of refuse and to speed loading and discharge is also being pursued.[28]

Management of Specific Wastes. Projects concerned with specialized techniques for dealing with particular types of waste are aimed at a small volume of the total waste load that must be dealt with. Failure to deal adequately with this small volume of material can lead to problems of appalling magnitude.

Automobiles, for instance, are becoming a more and more difficult problem to solid waste management authorities across the Nation.[29] Recent developments in the steel industry have reduced the demand for scrap metal from automobiles. Disposal of abandoned vehicles has generally been undertaken by scrap-metal dealers as a profit-making enterprise, but this means of automobile disposal is becoming less available to municipalities as scrap metal margins of profit decline. A study-and-investigation project has been undertaken on this subject, the results of which include a set of guidelines for industry standards.

A demonstration project is being conducted to show the advantages of up-to-date techniques in the disposal of manure from dairy farms. In

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[28]American Public Works Association Research Foundation. Rail transport of solid wastes; a feasibility study; interim report: phase one. Cincinnati, U.S. Department of Health, Education, and Welfare, 1969. 168 p.

[29]Management Technology Inc. Automobile scrapping processes and needs for Maryland; a final report on a solid waste demonstration. Public Health Service Publication No. 2027. Washington, U.S. Government Printing Office, 1970. 64 p.

this project anaerobic lagoons are used for storage of manure during seasons when use of the manure as fertilizer is not possible, with disposal of the manure being accomplished by means of scheduled application of farmland.

Problems in disposing of waste wood and other bulky burnable objects may be subject to solution by use of techniques currently being demonstrated by another Bureau grant.

Planning for Area-Wide Solid Waste Management. Many study-and-investigation grants were made under the provisions of the Solid Waste Disposal Act for the support of management surveys and development of consolidated area-, region-, and county-wide solid waste management plans. It is hoped that these plans will soon lead to implementation of the proposals for consolidated collection and disposal programs as indicated by the results of the surveys. These studies point out the disadvantages of fragmented refuse disposal systems and, thereby, illustrate the advantages, economics, and overall system improvements that may be gained through regional solid waste planning and management. The Bureau has already published too many of these reports to cite them individually; the Bureau's completed publications listing is available.[30] Mention of a few of these reports, however, will suggest the range of studies and investigations.

The Quad City (New Jersey) regional project effectively demonstrated the establishment of a regional solid waste district--one of the first

[30] Bayless, Publications of the Federal solid waste management program.

in the nation.[31] The Des Moines (Iowa) project provided substantial information on both the detailed organization of an intergovernmental solid waste collection and disposal agency and the detailed plan and analysis of the collection routes and system.[32] The New Orleans (Louisiana) project, very comprehensive in nature and covering one of the larger metropolitan areas, provided one of the first attempts at developing a master plan for solid waste collection and disposal.[33] The Genesee County (Michigan) project demonstrated the manner in which communities and industry can work together to develop alternatives for improving present solid waste practices. These studies and others like them are expected to serve as blueprints for other regions throughout the country.[34]

Equipment Evaluation. As new equipment is developed for the management of solid wastes and comes on the market or is reduced to standard engineering practice, unbiased evaluations of the performance and utility of such equipment becomes increasingly valuable. Grants by

[31]Quad-City solid wastes project; an interim report, June 1, 1966 to May 31, 1967. Cincinnati, U.S. Department of Health, Education, and Welfare, 1968. [181 p.]

[32]Henningson, Durham & Richardson, Inc. Collection and disposal of solid waste for the Des Moines metropolitan area; a systems engineering approach to the overall problem of solid waste management; an interim report. Cincinnati, U.S. Department of Health, Education, and Welfare, 1968. [324 p.]

[33]Albert Switzer & Associates, Inc., and Greenleaf/Telesca. Master plan for solid waste collection and disposal; tri-parish metropolitan area of New Orleans; final report on a solid waste management demonstration. Public Health Service Publication No. 1932. Washington, U.S. Government Printing Office, 1969. [359 p.]

[34]Solid waste disposal study; technical report; Genesee County, Michigan, June 1968. Cincinnati, U.S. Department of Health, Education, and Welfare, 1969. [251 p.]

the Bureau of Solid Waste Management are made in this area in order to expedite the development of equipment, the incorporation of improvements, the correction of faults, and the acceptance of valuable innovations by solid waste management personnel at all levels of local and State government.

Miscellaneous Projects. Several miscellaneous projects, which show promise of developing solutions for national solid waste disposal problems, or of contributing to the solution of such problems, have been approved for support by the Division of Demonstration Operations. These projects are of a varied nature, and include training programs, demonstrations aimed at segments of the general public other than those directly concerned with solid waste management, and projects directed to the consideration of special situations existing in particular circumstances.

Conclusion. Demonstration project grants have an important part in the Bureau of Solid Waste Management program, allowing an early start to be made on the implementation of the measures to deal with the nationwide solid waste management problem. Final results from the many projects currently in progress will be of immeasurable value in identifying fertile avenues of research, mobilizing popular support, enlisting the aid of the scientific and technical community, and pointing up the basic problems that must be solved.

ACTIVITIES IN SOLID WASTE MANAGEMENT, 1966-1970 (cont'd.)

Research Operations

The earliest research undertaken in solid waste management was

carried out through research grants beginning in FY 1960.[35] The intramural research program was not initiated until FY 1967.[36] Early efforts were applied to the planning for the present experimental compost plant facility now located in Johnson City, Tennessee, and the development of the laboratory operations presently located in two sites in Cincinnati. These laboratories were established to perform necessary service functions to support other efforts of the Bureau, as well as to begin the conduct of intramural research and development for better solid waste management. The tasks associated with analyzing samples from field investigations conducted as part of studies sponsored by various elements of the Bureau represent a significant, but ofttimes unheralded, effort.

Early in fiscal year 1968, the first modest resources were applied to several intramural research and development projects. The efforts were carried out by the laboratory facilities located at 5555 Ridge Avenue and at 5995 Center Hill Avenue, Cincinnati. The Office of Program Development coordinates the efforts made in extramural projects with the efforts undertaken by the staff of the Division of Research and Development within these facilities. In several instances, cooperative work with other governmental agencies has been undertaken.

Research and Development Matrix. The research and development efforts for better solid waste management are organized to attack the problem in

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[35]Lefke, L. W., A. G. Keene, R. A. Chapman, and H. Johnson, comps. Summaries of solid waste research and training grants--1970. Public Health Service Publication No. 1596. Washington, U.S. Government Printing Office. (In press.)

[36]Breidenbach, A. W., comp. Summaries of solid waste intramural research and development projects. Washington, U.S. Government Printing Office, 1971. 24 p.

segments that would form the basis for a research and development matrix (Figure 3). A discussion of the segments of this matrix will provide an introduction to the national research and development program carried out under the authority of the Solid Waste Disposal Act.

Five sources of solid waste have been identified These are: residential, commercial, industrial, agricultural, and institutional. Solid waste, regardless of the point of origin, must be managed through a series of unit operations. Research and development is needed in every phase of such operations. The following paragraphs discuss the problem from the point of view of the individual segments of the matrix.

Source Reduction. All solid waste has a distinct point of origin; that is, the location where the substances are discarded. It follows that this point of origin, if accurately defined, may provide a key for the modification of some of our present solid waste patterns. Source reduction encourages the concept of decreasing the amounts of solids entering the waste stream at the very point of generation. We are all aware of items which become wastes soon after we acquire them. They appear as boxes, cases, wrappers, bags, bottles, cans, envelopes, and a myriad of other items. Thoughtful consideration, education, and decisions are required if we are to stabilize or reduce the amount of solid wastes generated per capita. The effort, ambition, and ingenuity that are applied to the design of today's attractive packaging is a credit to those who compete for our various consumer markets. The packaging industry should be encouraged to apply the same level of ingenuity and innovation to the design of packaging that might be readily

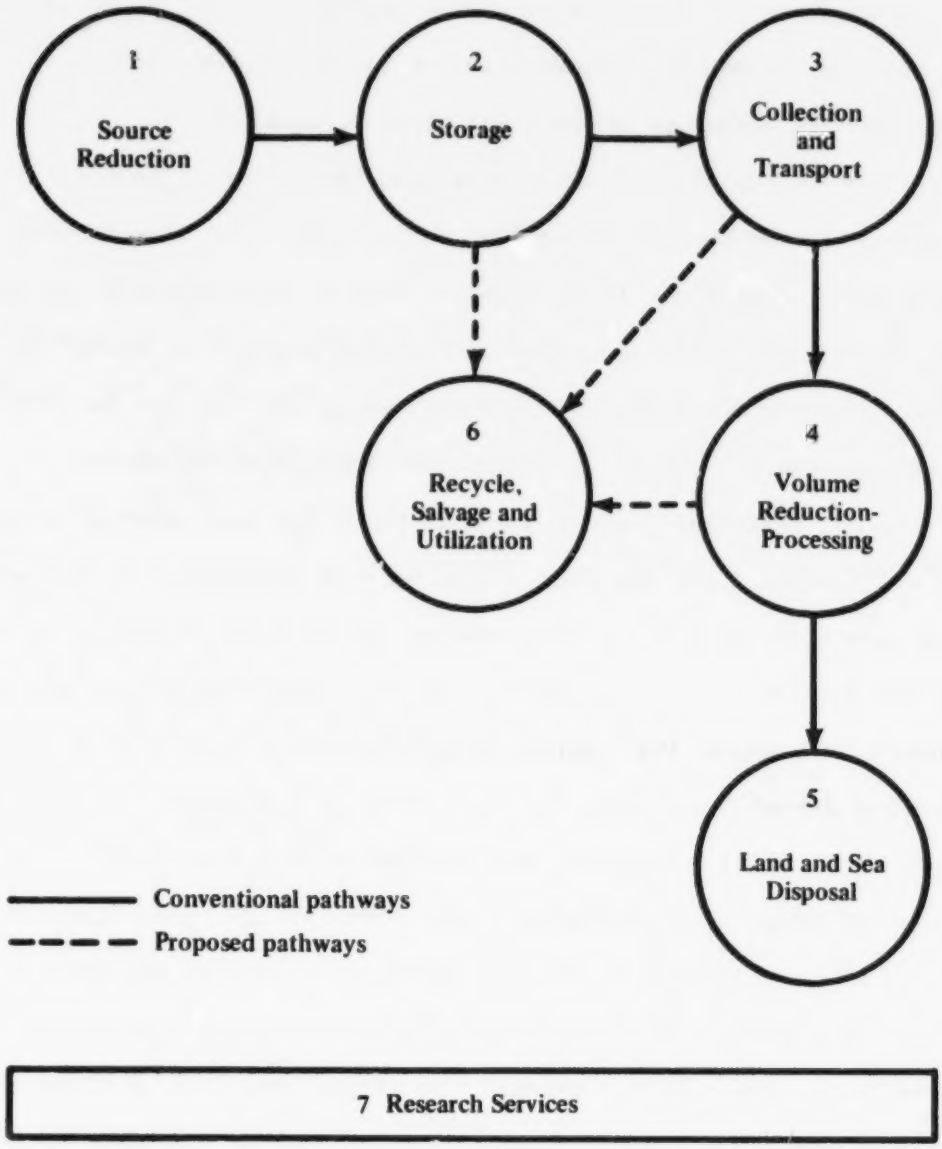

Figure 3. The research and development program matrix developed by the Bureau of Solid Waste Management.

reclaimed or, at least, that might lessen the solid waste management problem. Some groups have begun action in this direction.

Storage. Every producer of solid wastes must provide a method of holding or storing the wasted material while awaiting collection. Even the housewife with a garbage grinder is no exception, in that the grinder eliminates only the problem of garbage storage. The storage system employed has a direct effect upon the environment of the area in which the waste is produced. Poor storage of solid wastes provides sustenance for rodents and insects, produces unpleasant odors, provides fuel for fires in and around the storage areas, and prevents the efficient and economic collection of the solid waste materials.[37] All aspects of solid waste management may have their effect upon the environment, but storage and collection are more nearly related to the solid waste problem as viewed by the average citizen. This problem literally is at the citizen's very door. Inadequacies affect him directly, quickly, and with great impact.

It should be noted that solid waste storage--except for larger containers--has not changed appreciably since man found it necessary to remove his waste from his immediate environment. The static storage system has perpetuated a collection system, for the most part, of similar antiquity.

Collection and Transport. The collection and transport of solid wastes is a connecting link between storage and processing or disposal

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[37] [Black, R. J.] Safe and sanitary home refuse storage. Public Health Service Publication No. 183. Washington, U.S. Government Printing Office. Revised 1962, 1968. 6 p.

and is affected by each of these. Poor storage and illogical disposal practices adversely affect the collection process. It is estimated that 70 to 80 percent of the cost of solid waste management is accounted for by the collection and transport aspect. This portion of the service has been considered disposal of waste by the citizen. He has demanded rapid removal of solid waste from his property--considering the job complete when the truck has disappeared around the corner. It seems natural, then, that funds for collection services have been more obtainable than those for ultimate disposal sites. Funds, however, have been used mostly for more trucks, bigger trucks, and increases in manpower. New techniques for collection, in combination with improved storage, are necessary to management of the burgeoning solid waste problem. Land that is suitable for disposal of solid wastes is rapidly being preempted for other purposes. The people in suburbia naturally resent the placement of disposal sites nearby. The noise and impact of concentrated vehicular traffic poses additional problems in area and route selection. For these reasons and many more, the transportation of solid wastes is becoming increasingly expensive and time-consuming. A comprehensive evaluation of collection and transport, evaluated as a system, can often produce economics of operation and design so that service can be improved without attendant degradation of the environment. Investigations conducted within the recent National Survey of Community Solid Waste Practices show that for 14 percent of the communities reporting, both separate and combined collection are used sporadically and unpredictably, an inconsistency not in keeping with economic operation. The survey also

indicates that over 12 percent of the citizens are not served by any collection system. [38] Improvements in collection and transport systems technology should provide these areas of economic and environmental conflict with improved service systems.[39]

Volume Reduction Processing. With urban land utilization, land disposal areas for solid waste are becoming scarce. Sanitary landfill, the technique of the engineered disposal of solid wastes on land, reduces the volume of wastes as a function of normal operation. Any process or system that will further reduce the volume of wastes is extremely desirable. Such a process could add years of additional service to existing landfill sites, reducing the need for future sites. Volume reduction processing systems, such as incineration and composting, whether or not byproducts of the operation are fully exploited, may be the method preferred for decreasing refuse volume. Such systems at the present time may produce incidental pollution, thus diminishing their value to the community. All too often air pollution, water pollution, and vector problems accompany attempts at volume reduction. Although present systems may be employed without degrading the environment, often the cost of protection precludes their use. Studies of existing methods and

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[38]Black, R. J., A. J. Muhich, A. J. Klee, H. L. Hickman, Jr., and R. D. Vaughan. The national solid wastes survey; an interim report. [Cincinnati], U.S. Department of Health, Education, and Welfare, [1968]. 53 p. Reprinted in Proceedings; Third Annual Meeting, Institute for Solid Wastes, Miami Beach, Oct. 24, 1968. Chicago, American Public Works Association. p. 24-43.

[39]Ralph Stone and Company, Inc., Engineers. A study of solid waste collection systems comparing one-man with multi-man crews; final report. Public Health Service Publication No. 1892. Washington, U.S. Government Printing Office, 1969. 175 p.

innovations in similar techniques are sought to provide economic and adaptable concepts in volume reduction methods to preserve land areas. The 1968 National Survey of Community Solid Waste Practices indicated that less than 9 percent of the citizens are served by incinerators, the major method of volume reduction prior to disposal.[40] Presently, more than 80 percent of these incinerators are degrading the environment with air pollution, water pollution, visual blight, and vector proliferation.

Land and Sea Disposal. Approximately 6 percent of the nation's land disposal sites are acceptable by present environmental standards. The open, sometimes burning, dump is the rule rather than the exception. New and better methods of solid waste disposal upon the land must be developed to preserve environmental integrity. Presently acceptable methods must be evaluated and adopted by even the smaller governmental entities. Cost-benefit methods must be applied to the utilization of land as well as water and air. But as more stringent regulations for land disposal techniques are applied, there is a tendency for government and industry alike to seek other areas of ultimate disposal. Communities and industries in coastal areas view the sea as a natural sink for solid wastes. Because of the immediate and continuing pressure to use the sea, we need factual information on the extent of sea disposal priorities. We must consider, from a base of scientific data, the consequences of sea disposal upon the marine environment and the ecology of the sea.[41]

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[40] Black, et al. The national solid wastes survey; an interim report.

[41] Smith, D. D., and R. P. Brown. Ocean disposal of barge-delivered liquid and solid wastes from U.S. coastal cities. Public Health Service Publication No. 2113. Washington, U.S. Government Printing Office. (In press.)

Reclamation. Several factors justify projects in the reclamation category: (1) the volumes and weights of solid waste requiring ultimate disposal can be decreased by removing portions of the wastes for salvage, reuse, or recycling; (2) some value does remain in the materials heretofore discarded; (3) the basic raw materials used in the production of goods are lost to us permanently when solid wastes are disposed of by the methods presently applied.[42] Pertinent salvaging techniques are generally too costly to provide the incentive of profit or a marginal cost return. Conservation of our national resources, including land areas for disposal and reclamation of despoiled land, may be realized through the development of adequate mechanical sorting and classifying devices. New methods of utilization made possible by innovations in recycling and reclaiming materials present in the waste stream may prove advantageous. Regardless of the location of the resource, recycling, or reclaiming operation, materials removed at any time will ultimately reduce the final disposal quantity. This factor alone may prove timely as our national production rate of wastes is increasing. Naturally, one of the first sources of recyclable material is any process that produces a large quantity of waste products which are of uniform, consistent quality. As separation and classification techniques become more sophisticated and efficient, materials intimately mixed with other wastes

[42]Drobny, N. L., H. E. Hull, and R. F. Testin. Recovery and utilization of municipal solid waste; a summary of available cost and performance characteristics of unit processes and systems. Public Health Service Publication No. 1908. Washington, U.S. Government Printing Office, 1971. 118 p.

may assume new economic importance.[43] The recycling and reuse of our natural resources is a basic tenet, held by all, yet unfortunately followed by few. Present attempts at these reuse methods have been limited--usually to indiscriminate hand-picking by unfortunate individuals who are looking for more satisfactory employment. Once solid waste is received at a disposal site, only a small portion is recycled.

Research Services. Since most solid waste is unusable or unwanted, there has been a normal reluctance to identify quantities and sources or to develop methods of characterizing, in any meaningful way, the discards themselves. Before success can be obtained in improving solid waste management, many basic questions must be answered. A few of these are: (1) What are the normal characteristics of solid waste? (2) How can representative samples of such a heterogeneous mixture be made? (3) What analytic methods should be used to define these characteristics? (4) Do pesticides and other toxic materials persist in solid wastes? (5) What are the potential health hazards in a given solid waste management system?

The answers to these and other questions are of concern to all engaged in research and development. Studies in this segment of research and development are designed to provide the basic tools which are necessary to solve the problems represented in the other segments of the matrix.

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[43] Engdahl, R. B. Solid waste processing; a state-of-the-art report on unit operations and processes. Public Health Service Publication No. 1856. Washington, U.S. Government Printing Office, 1969. 72 p.

Modes of Funding. There are four methods of accomplishing research and development that can be employed under the Solid Waste Disposal Act of 1965. These can be listed as: intramural efforts, contract efforts, research grant contributions, and demonstration grant activities.[44] The usefulness of these modes of funding--within a mission-oriented, matrix-directed program--depends upon the urgency, scale, complexity, and resource requirements of the tasks to be accomplished. The following paragraphs will discuss the first three of these modes of funding as they have been applied to the solid waste management problem by this Bureau. The fourth mode of funding, demonstration grant activities, has been discussed previously.

Intramural Research. Topics for intramural exploration have a high degree of flexibility, because control of project direction is continuously close to the work itself. Success with intramural work is dependent upon the ability to acquire competent investigators and managers, as well as suitable space and equipment within a reasonable time period. Intramural research must be supported by top-flight personnel recruitment and procurement services.

An example of an intramural research project is the project to design and test a high-temperature incinerator for small-sized population units. The project is directly associated with the needs for

[44]For a complete description of research projects, including funding, description of objectives, and progress to date, see the current editions of Public Health Service Publication Nos. 1596, 1821, 1897, and Breidenbach, A. W. Summaries of solid waste intramural research and development projects. Washington, U.S. Government Printing Office, 1971. 24 p.

new concepts in refuse incineration that will present alternatives to conventional incineration techniques. In the current phase of the project, the design of the incinerator is complete, and procurement of necessary parts is in progress.[45] It is anticipated that the incinerator will soon be assembled and testing will begin. The potential benefit of this project, if successful, will be an adequate means of incineration for communities in the 10,000-to-50,000 population bracket.

Another intramural research project has as its objective definition of the microbiological quality of the total effluent and immediate improvement of current- and to-be-developed incineration processes. Microbiological data are being taken to form baseline information for future use in assessing the efficacy of new and modified incineration processes.[46] Five incinerators have now been tested, and we anticipate that in another year we will have the information from a sufficient number of sites to establish the needed baseline information.

Contract Research. Contract research minimizes the space and personnel considerations inherent in intramural research and permits mutual agreement as to what is to be accomplished before the contract is negotiated. Such research requires close supervision by a knowledgeable

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[45]Breidenbach. Summaries of solid waste intramural research and development projects. See also, King, D. A. Development of a high-temperature, low capacity refuse incinerator; a Division of Research and Development open-file progress report (WP-03-68-08). [Cincinnati], U.S. Department of Health, Education, and Welfare, 1970. 29 p. [Restricted distribution.]

[46]Peterson, M. L. Pathogens associated with solid waste processing; a progress report. [Cincinnati], U.S. Environmental Protection Agency, 1971. 26 p.

and, in most cases, senior scientist or engineer. The contract is a legal document, and those engaged in contract research are looked upon as ex-officio members of the intramural research team. The variety and extent of our research contracts are promising signs of a coming expansion of solid waste technology and fruitful business-government research relationship.[47]

An example of contract research is the subscale experiment program for the Combustion Power Unit-400.[48] These experiments are a planned follow-up to feasibility studies completed during fiscal year 1969. This study showed that it may be economically and technically feasible to use the waste heat from the controlled fluid-bed incineration of municipal solid waste to generate electricity with the aid of a gas turbine. The subscale experiments will permit evaluation of the new principles in combustion as well as particulate reduction necessary to the successful implementation of this concept. By the end of fiscal year 1970 we expect to have the information necessary to permit a decision on the construction and testing of a prototype power-generating incinerator. Success with this particular project would result in substantial reduction of costs in volume reduction by incineration.

A second example of the Bureau's contract research is a study of the relationship between packaging materials and waste disposal. This

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[47]Clemons, C. A., and R. J. Black. Summaries of solid wastes program contracts, July 1, 1965--June 30, 1968. Public Health Service Publication No. 1897. Washington, U.S. Government Printing Office, 1969. 46 p. Supplement (insert), July 1, 1968--June 30, 1970. 38 p.

[48]Combustion Power Company, Inc. Combustion power unit-400; CPU-400; a technical abstract. Rockville, Md., U.S. Department of Health, Education, and Welfare, 1969. 15 p.

study determined the present proportions for types and volumes of packaging materials and indicated trends to the year 1976, with anticipated effects on solid waste management problems.[49] Means of making changes in packaging to mitigate such problems were suggested. The work accomplished is the necessary first step toward the objective of redirecting these materials away from the waste stream and thus reducing the amount of waste remaining to be managed. With the basic data available from this effort, it should be possible to initiate definitve studies and move further toward the objective of minimizing solid waste management problems associated with packaging materials.

Research Grants. This mode of research provides the investigator with a high degree of freedom. The grantor has but modest control over the direction of the research, once the funds are awarded. Reports and publications are related to the freedom of the investigator and are not counted on in the same manner as in a time-sequenced research and development program. Research grants can provide excellent opportunities for exploratory research of high-risk concepts where some initial free-lance investigative efforts minimally related to a time-sequenced matrix are desirable. Thus, the Bureau of Solid Waste Management supports a wide variety of research projects through the grant mechanism.[50]

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[49]Darnay, A., and W. E. Franklin. The role of packaging in solid waste management, 1966 to 1976. Public Health Service Publication No. 1855. Washington, U.S. Government Printing Office, 1969. 205 p.

[50]Lefke. Summaries of solid wastes research and training grants.

An example of research grant effort is that being conducted at the University of Pennsylvania on pipe transport of domestic solid wastes. Objectives are to investigate the application of known technology of solid transport in pipes for the collection and removal of solid waste as well as economic comparison with truck collection systems. This basic research on a new and radically different collection system has potential application not only in future model cities but may well be feasible to replace existing collection systems in established cities, if the cost of this installation is amortized over a 50-year period.

Another example of effort being conducted through the research grant mechanism is the grant entitled "Pyrolysis of Solid Municipal Wastes." This work, being performed by the City of San Diego, has as its objective the investigation of the feasibility of pyrolysis as an economic method of decreasing the volume of solid wastes, the production of useful by-products, and the determination of the optimum conditions for operation of the process.

Characterization studies have been made to form the basis of pilot-plant charge materials. The municipal solid wastes are being pyrolyzed at various temperatures, and the resulting solid, liquid, and gas products collected and analyzed. Typical samples have been pyrolyzed at temperatures of 90 F, 1,200 F, 1,500 F, and 1,700 F, using a sample density of 5.55 lb per cu ft. The products to date consist of gases, liquid pyroligneous acids, and somewhat contaminated charcoal.

Conclusion. It is hoped that through research and development we may devise new and improved technology which will help in the

management of a variety of solid wastes generated within the United States. These techniques, however, cannot effectively mitigate the present problem of poor solid waste management unless four additional elements can be assured: (1) increased awarness and concern of the average citizen for his individual, community, and corporate solid waste management problems[51]; (2) cooperative regional and community action--through professional leadership--to manage solid wastes effectively; (3) the efforts in college and university of faculty and students, who possess the ingenuity and innovative expertise, to bring about new solutions; and (4) the well-known capability of the industries that form the backbone of American technological progress. Thus, if the citizen, the community, the university, and industry will help to create and to test a new technology, the millions of tons of wastes generated each year can perhaps be channeled, used, recycled, managed, and transformed into millions of tons of American assets.

ACTIVITIES IN SOLID WASTE MANAGEMENT, 1966-1970 (cont'd.)

Technical Operations

The formalized activities of the technical services branch of the Office of Solid Wastes began with the establishment of Cincinnati-based operations in August 1966. At that time, the technical services activity was structured into two, and later into four, sections: planning,

[51]National Association of Counties Research Foundation. Citizen support for solid waste management. Washington, U.S. Government Printing Office, 1970. 20 p. [Also published as chap. 8 of Public Health Service Publication No. 2084. In press.]

engineering investigations, chemistry and biology, and operations research. When the Office of Solid Wastes was reorganized as the Solid Wastes Program in 1967, a number of other changes took place. The chemistry and biology section was transferred to the research and development activity; the operations research and planning sections were formed into the systems and operations planning activity; and the engineering investigations section became the technical services activity.

The most recent reorganization, in early 1969, established the Division of Technical Operations by merging the systems and operations planning and technical services activities with the responsibility for technical assistance, planning grants direction, planning assistance, basic data development, establishment of standards and criteria and the application of the management and mathematical sciences to solid waste management.

The Division of Technical Operations was organizationally structured into four branches to carry out its portion of the Bureau of Solid Waste Management's program: Technical Assistance and Investigations Branch, Operational Analysis Branch, Basic Data Branch, and Systems Management Branch. Technical advisors serve as the primary technical resource to the Division on particularly complex solid waste problems and assist in the review and coordination of Division projects.

Technical Assistance and Investigation Branch. Provides consultation, advice and assistance to public and private organizations, agencies, and individuals in the development and conduct of solid waste management systems.

Basic Data Branch. Develops, collects, and interprets basic data related to solid waste management systems through the conduct of technical studies and evaluations, cooperation with related agencies, and the operation of the national data network.

Systems Management Branch. Manages a program of planning grants to State and interstate agencies and assists in the planning and implementation of solid waste management systems through consultation; promulgation of recommended guidelines, model legislation, ordinances and codes; application of the management sciences.

Operational Analysis Branch. Applies mathematical and social sciences to the solution of solid waste problems and provides assistance to public and private organizations, agencies, and individuals through the use of the physical, mathematical, and social sciences.

The Division of Technical Operations (DTO) is charged with the primary responsibility of providing the assistance authorized in the Act, and shares the responsibility for investigations, surveys, and other studies with other divisions of the Bureau. The Division is concerned with the collection, interpretation, dissemination, and application of knowledge to solve present problems to achieve improvements of operations presently considered to be unacceptable, or to further upgrade acceptable operations.

Fulfillment of DTO goals requires that the Division's activities be intimately involved with the ongoing technical operations of existing and proposed solid waste management systems. The activities to bring about the needed improvements with the present state of solid waste

technology require field efforts to attempt immediate solutions, the study and analysis of existing technology, the collection and dissemination of basic data as needed for problem solving, and the investigation of methodologies from related fields for possible application to solid waste management.

Program activities were analyzed and evaluated in late FY 1969, and the Division formulated a long-range program plan which was incorporated into the Bureau's program management plan. The plan was implemented in FY 1970.

The program is designed to help meet the long- and short-range objectives as exemplified by a problem matrix (Table 4), and to support assistance activities, the management of the planning grant programs, the collection, analysis. and application of the needed basic data for problem solving, the interpretation and application of new emerging technology, and the training of DTO personnel to develop the skills needed to meet the responsibilities of the Division.

Each DTO project may be easily referenced to the matrix to illustrate the interrelationships of each project to the existing problems in solid waste management and to meet the Bureau goals. The matrix displayed was published in the 5-year project plan Issue Study on Solid Wastes, by the U.S. Department of Health, Education, and Welfare, in August 1969.

The provision of assistance by the Bureau as authorized by the Act is through both direct and indirect response to requestors (Figure 4). The direct assistance response is provided by contact

TABLE 4

SIMPLIFIED SOLID WASTE MANAGEMENT MATRIX

Flow chart segment	Waste sources				
	1 Residential	2 Commercial	3 Industrial	4 Agricultural	5 Institutional
A. Generation	X	X	X	X	X
B. Storage	X	X	X	X	X
C. Collection	X	X	X	X	X
D. Transport	X	X	X	X	X
E. Processing	X	X	X	X	X
F. Disposal	X	X	X	X	X
G. Management	X	X	X	X	X
Legislation	X	X	X	X	X
Financing	X	X	X	X	X
Socio-political arrangements	X	X	X	X	X

BUREAU OF SOLID WASTE MANAGEMENT ASSISTANCE CYCLE

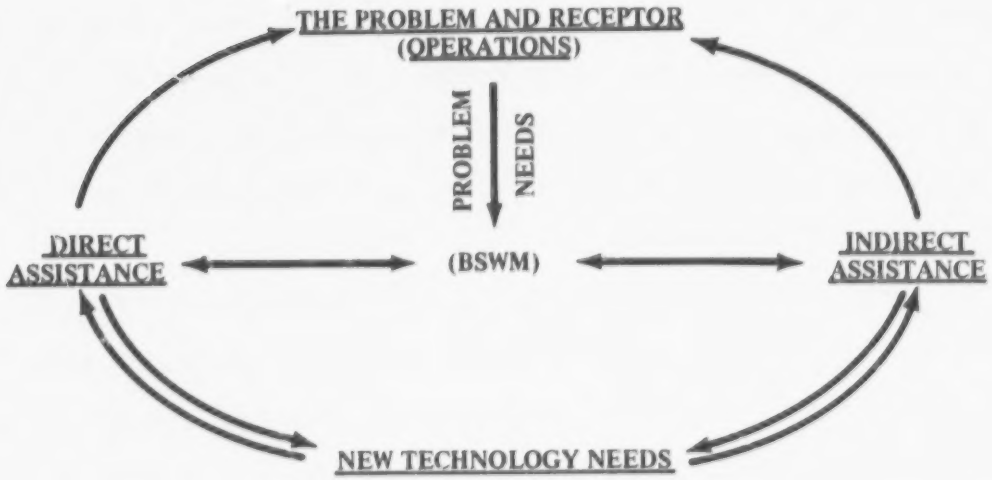

Figure 4. The provision of assistance by the Bureau of Solid Waste Management, as authorized by the Solid Waste Disposal Act, is by both direct and indirect response to requestors.

between Bureau personnel and the receptors. The indirect assistance is provided by the collection and dissemination of information and data related to the various aspects of solid waste management.

There are, of course, significant interrelationships between the two forms of assistance. Knowledge gained from intramural projects is applied directly to the field by the direct assistance staff and indirectly by Bureau publications. The experiences gained by the direct technical assistance activities provides a feedback to the intramural projects for data and information needs and to the research and development programs for new technology needs. Consequently, the direct and indirect assistance activities are closely interrelated to create a dynamic, comprehensive approach to achieving a significant portion of the Bureau mission.

Planning Grants. The effectiveness of the communities of this Nation in the sanitary disposal of more than a billion pounds of solid wastes daily is determined, in a large part, by the amount and quality of planning that takes place, and inter- and intra-community cooperation that is effectuated. Under present practices, it remains the State's responsibility to develop a State solid waste management plan which encourages, guides, and accommodates local and regional solid waste planning efforts.

Prior to 1960, few States had operative solid waste programs, and it was partly in recognition of this that Congress included under the Solid Waste Disposal Act the provision of grants to State and interstate agencies of up to 50 percent of the cost of developing solid waste

plans. The first of these grants was awarded on June 1, 1968, and since then 41 States, plus the District of Columbia, Guam, and Puerto Rico, as well as 5 interstate agencies have been awarded over $5 million in matching grants to plan for effective solid waste management. These grants represent a combined total of 129 project years and 640 man-years. The funds have been divided mainly among: survey (60%), planning (10%), and other activities (30%), such as public relations and development of legislation.[52]

The prime objective of the State and interstate grant is to foster comprehensive Statewide programs in planning for the handling and disposal of solid wastes. In developing their plan, the grantees consider such factors as population growth, urban and metropolitan development, land use planning, water pollution control, air pollution control, regional disposal programs, and the management of solid wastes in general.

It was recognized early that adequate planning could not go on without reliable data on current solid waste practices. The Bureau and the cooperating States jointly developed necessary survey forms and a manual of instructions for conducting an on-going survey to gather solid waste statistics. The collected data is processed by the Bureau for the States and returned to the States for their individual use.

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[52]Toftner, R. O., D. D. Swavely, W. T. Dehn, and B. L. Sweeney, comps. State solid waste planning grants, agencies, and progress--1970; report of activities through June 30, 1970. Public Health Service Publication No. 2109. Washington, U.S. Government Printing Office, 1971. 26 p.

The data is serving as the basis for the National Survey of Community Solid Waste practices; an interim report on the survey was presented in October 1968.

Planning grant recipients render a yearly report to the Bureau of Solid Waste Management.[53] Grants usually are made for a period of three years. Because of different levels of effort, together with different starting dates according to the award of the planning grants, these reports show a broad range of progress and accomplishments, with the common element being that the first effort of each grantee has been to survey solid waste practices and problems within his jurisdiction. Usually, when there has been time to do so, grantees have actively promoted legislation and the appropriate administrative regulations for more effective control of solid waste activities. They have also provided training for agency staffs involved with solid wastes and have coordinated their programs with those of other related State, regional, and local planning units. All of these efforts are aimed at the formulation of comprehensive solid waste management plans. Many other corollary activities are carried on as a desirable implementation to planning.[54]

A good legislative apparatus for dealing with the problem does not, of course, by itself solve the problem. There is a built-in resistance

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[53]Toftner, et al. State solid waste planning grants, agencies, and progress--1970.

[54]Toftner, R. O. Developing a state solid waste management plan. Public Health Service Publication No. 2031. Washington, U.S. Government Printing Office, 1970. 50 p.

to comprehensive solid waste management, which will have a negative effect whether that effect is recognized in planning or not. Only quite recently have responsible planners begun to realize that the fundamental problems of solid waste management also include such matters as the structure of the modern community and the cultural attitudes of its citizen, as well as considerations of technology, economics, and resources utilization. The interrelationships of these factors and the manner in which they affect problems of area planning are complex.

Urbanization. The urbanization following World War II revolutionized our concepts of urban life. Because of the growth of suburbia, the problem of solid waste management has expanded to area-wide proportions, beyond the resolving power of the communities that existed prior to the war. That is to say that the growth of the population has contributed to the growth of the problem to such an extent that it can no longer be handled by any one of the myriad of separate jurisdictions that make up the overall community. In areas where an explosive increase in population had a maximum impact, urbanization has progressed beyond the limits of cities and their satellite suburbs and become a characteristic of rural communities as well. With high land values and heavy investment in fixed installations dedicated to specialty enterprises, this rural sector of the community surrounds the urban-industrial-suburban sector as epithelium that has lost its elasticity and is a thick enough shell to have a profound effect on both its own and the nearby cities' problems of waste management.

Cities have traditionally dealt with wastes by transporting them beyond their own immediate confines and discarding them in the least

expensive way tolerable, advancing from city dump to landfill or incinerator as necessity compelled. Since World War II, however, freedom to manage wastes so simply has been curtailed. The once-rural shell is difficult to penetrate except at extremely long-haul distances, which often must be judged to be prohibitively expensive. In most cases, however, the alternative of retaining the wastes within the city has been even more unsatisfactory. Land area is at a premium, and land use planning is generally not advanced enough to include refuse disposal objectives. Moreover, the constraint is exacerbated by air pollution considerations that limit the combustion of wastes, as well as by the consideration that the urban core itself may consist of several incorporated cities, each limited by its own geographical and jurisdictional limits. In the San Francisco Bay area, some 83 separate but impinged jurisdictions and agencies seek to put solid wastes off on one another at 77 different locations, all of which are under the watchful eye of a most vigorous air pollution control district.

Just as the city is confined by the surrounding rural section, it in turn exerts pressure against the air-polluting, water-polluting, vector-producing, and other adverse environmental potential of that sector. Urban subdivisions press hard against the dairies, the egg and poultry establishments, and animal feeding enterprises. In California single installations may fatten 3,000 to 6,000 steers annually; others maintain 10,000 to 100,000 hens. The fly-breeding potential of the 200 million cubic yards of animal manures produced each year at the zone of contact between urban and rural installations in California is almost

astronomical. Against such zones, the city presses with enforcement of nuisance-abatement laws and extension of city limits which may overwhelm agricultural enterprises with ruinous taxes. Both fixed taxes and the unavailability of land further away confront the farmer with the choice of either going out of business or solving his own environmental problems. Collection of manures is expensive, and its disposal on land beyond the confines of the community is as difficult as the disposal of urban solid wastes.

There are other problems of solid waste management in a modern community that derive from agriculture pursuits in a high-density rural sector, such as the burning of tree trimmings and other plant residues, which accentuates the air pollution problem. It is obvious then, that in a modern community consisting of impinged urban, industrial, suburban, and high-investment agricultural sectors, the problem of solid waste management calls for a community-wide approach for which the existing fragmented jurisdictions are inadequate.

Public Attitudes. The attitudes of individual citizens and their elected officials also contribute to the problems inherent in solid waste management. Any material becomes a waste when its owner or producer no longer considers it of sufficient value to retain. To suggest that if he wishes to get rid of it he should invest more money in it, is considered absurd, despite the fact that he may object to polluted water, smog, rats, unsightly debris, and other negative conditions resulting from his loss of interest in ownership.

In the face of this phenomenon, engendered in a Nation in which there was formerly room to throw away everything, many engineers and

officials responsible for solid waste management have been reluctant to do what they are paid to do. They have retreated again and again on the dollar cost of solid waste management systems rather than helping the public to understand that waste management is worth what it costs. The administrative official, again operating on traditional principles, has often mistaken a policy of no spending at all for the ideal goal of municipal government, not realizing that the 19th-century policy of laissez-faire, when applied to current waste problems, equals pollution of land, water, and air.

The result has been that the public has tended consistently to underestimate the amount it can "afford" to spend for solid waste management. This in turn has caused dump operators to function at the limit of public tolerance until, currently, in many localities a public reaction against the landfill and incinerator is taking place and producing a demand for better methods, which ultimately may involve even higher costs.[55]

A realistic solid waste program must thus include awareness that the public is largely uninformed, unwilling to invest in waste management, and at the same time is highly sensitive to the negative aesthetic values resulting from this very condition.

The educational program associated with the Bureau of Solid Waste Management is clearly related to the problem of statewide and area

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[55]Brunner, D. R., S. J. Hubbard, D. J. Keller, and J. L. Newton. Closing open dumps. Washington, U.S. Government Printing Office, 1971. 19 p.

planning, because of the lack of education among the very persons who do that planning. While public health officials are generally aware of the nuisance and vector problems associated with careless handling of refuse, and engineers generally have a smattering of knowledge pertinent to solid wastes programs, the planners, public administrators, lawyers, and financiers who deal with urban problems get essentially no educational introduction to the problem. Especially profound is their ignorance of the nature and potential of alternative methods of disposal and their effect upon land, water, and air resources. For example, a public official who opposes landfilling often cannot understand why incineration or composting is not adopted instead. No one has explained to him that neither of these does more than reduce the amount and alter the nature of material that <u>still</u> must be disposed of on land. Discussion of waste problems then tends to center merely on costs in dollars of programs which by themselves will not take care of the problem, no matter how many dollars are spent. Multiply this confusion by the number of jurisdictions involved in the consolidation of solid wastes planning, and one can appreciate the depth of the problem involved, and the concurrent need for the education of and in-depth consultation with those who would be the administrators of the programs which must be put into effect.

Accomplishments. The Bureau of Solid Waste Management Regional Representatives serve as the project officers for the planning grants and are therefore primarily responsible for the assurance that the grantees achieve the purposes of the grants. The DTO is responsible for the administrative and technical management of the planning grant program.

During FY 1967 and 1968, the primary effort in the planning grant program was devoted to handling routine requests relating to development, processing, and assessing the technical merits of State planning grant applications. Numerous site visits were made to discuss technical problems with State representatives. The reviewing, processing, and funding of grants to the States was a continuing activity of the Planning Section.

A publication was issued which listed all planning grants awarded, the recipients, the amounts, and the period of the grant. This publication has been periodically updated.[56]

Most of the effort in the planning unit in the last half of FY 1967 was devoted to formulating administrative and policy guidelines for reporting and assessing progress on the development of State solid waste management plans. Standards were developed for interim progress reports and continuation-year project reports used for all continuation projects. Copies of these standards were included with letters sent to those States due for continuation on June 1, 1968.

State-by-State progress as of January 1969 was described in Public Health Service Publication No. 1913, and 1970 progress abstracts for each solid waste disposal planning grant, are in the final stages of publication.

To further aid the States in developing their plans, the Division has developed a set of planning guidelines that provide basic direction

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[56]Toftner, et al. State solid waste planning grants, agencies, and progress--1970.

in the planning process.[57] These guidelines set forth the principles required for an agency to assess and evaluate its solid waste problems, establish objectives to overcome these problems, consider alternatives, and select a program to achieve the selected objectives. Guidelines are being developed for manpower planning in solid waste management. These guidelines will be oriented toward the operational planning level of solid waste management for any organization engaged in planning for the recruitment, selection, and hiring of professional, skilled, and semiskilled personnel on a long-range basis. Consultative services are being provided to States on a continuing basis to assist in preparing the State solid waste management plan.

Development of National Survey of Community Solid Waste Practices. Prior to the passage of the 1965 Solid Waste Disposal Act, few States had solid waste programs, although solid waste planning was becoming recognized as a desirable and necessary activity. It was also becoming evident that a thorough knowledge of solid waste conditions is prerequisite to developing comprehensive planning programs. But because of a lack of experience and personnel, most States were unable to develop and plan the required data-gathering activity. Thus the States, through the Conference of State Sanitary Engineers in July 1966, recommended that the Solid Wastes Program prepare a list of essential data and guidelines for conducting the Statewide surveys. The response to this request resulted in the formation of the National Survey of Community Solid Waste Practices.

[57] Toftner. Developing a state solid waste management plan.

The data listings, reporting forms, and specifications for the survey were developed over a period of more than five months through the joint efforts of representatives of the Solid Wastes Program, State agencies, and private consultants. The Survey provides information on the location, types and amounts of solid wastes being collected and their ultimate disposition. In addition to providing a waste inventory, the Survey indicates the resources (manpower, equipment, monies, facilities, etc.) required to carry out collection, reduction, and disposal activities. An evaluation of existing transfer, reduction, or disposal sites and facilities is also provided.

Survey Forms. The Survey reporting forms were designed for maximum flexibility. They may be used not only for individual communities but are also adapted to area-wide surveys, provided the areas are established on a geographically well-defined "community" basis, such as a county or a sanitation district. In order to provide flexibility, three separate forms are used: one to gather general information on the storage, collection, and disposal of solid wastes in the "community" and the other two for disposal site descriptions and evaluation purposes.[58]

The Community Description Report is used to obtain comprehensive information on the community's solid waste practices. Information about the community's size, organization for solid waste handling, its storage, collection and disposal systems and their costs, with the amount of

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[58]Muhich, A. J., A. J. Klee, and P. W. Britton. Preliminary data analysis; 1968 national survey of community solid waste practices. Public Health Service Publication No. 1867. Washington, U.S. Government Printing Office, 1968. 483 p.

solid wastes collected and disposed of is obtained. To this end, the form embraces four broad information categories: (1) storage, (2) collection, (3) disposal, (4) budget and fiscal.

The Land Disposal Report is used to determine the disposal capabilities, costs, and method of operation of all land disposal sites. The Facility Investigation Report provides information about the operating characteristics and capabilities of all solid waste reduction or disposal facilities within a State. The types of facilities to be considered include incinerators, grinders, crushers, transfer stations (land or water), compost plants, conical burners, and hog feeding lots. Both disposal site forms cover three general areas of information: (1) description and evaluation of site, (2) quantitative data, and (3) fiscal data. In addition, the facility form contains a separate section on the design features and operational characteristics of incinerators.

Survey Coverage. Initially it was recommended that the Survey examine as a minimum all incorporated places with a population of 5,000 or more plus all Standard Metropolitan Statistical Areas (SMSA's). Because of more specific needs, however, the States participating in the National Survey found it desirable to extend coverage to the smaller communities as well. Thus the actual extent of the survey far exceeded the suggested minimum.

All land disposal sites and facilities at which public and private collectors deposit solid wastes were to be surveyed, regardless of the size of the community the site served or whether it was publicly or privately owned or operated. However, so-called "promiscuous" unauthorized dumps at roadside or in public or private areas on which

dumping occurs on an irregular or infrequent basis are not considered land disposal sites for the Survey. Similarly, on-site disposal or reduction facilities such as apartment house incinerators and household garbage grinders are not considered facilities for the Survey. In addition, private disposal sites or facilities owned and operated by industrial, commercial, or institutional establishments and used solely for reduction or disposal of their own generated solid wastes were not surveyed. The same holds true for private or on-site disposal of agricultural wastes. Although some information on industrial and agricultural wastes was obtained on a community basis, in general no attempt was made to conduct specific industrial or agricultural surveys.

Implementation. Implementation of the National Survey was carried out by the State agency receiving the Federal solid waste planning grant in the first 12 to 18 months of the grant period. To obtain reliable data, the Survey was performed as a field investigation, with individuals or teams of data collectors actually visiting the communities and sites. Information was obtained either by personal interview or direct observation; under no circumstances was a form completed on a mailout and return basis.

In order to obtain consistent information for use in conducting the National Survey, the Solid Wastes Program developed a manual of instructions, including sample problems.[59] Each participating State

[59]Manual of instructions and sample problem for use in conducting the national survey of community solid waste practices. [Cincinnati], Solid Wastes Program, July 1967. 65 p.

received copies of this manual discussing in detail the survey forms, their interpretation and nomenclature.

To promote additional consistency, the Solid Wastes Program conducted seminars and workshops on the Survey with State personnel. By using the personal interview technique and by providing sufficient guidance to the interviewer through the instruction manual and seminar presentations, it was anticipated that the National Survey Data would prove to be both uniform and reliable.

Recording and Processing Survey Data. The States participating in the National Survey reported their survey results to the Solid Wastes Program by returning completed Federal forms, appropriate State-designated forms, or returning survey data transferred to punched cards. The first method was the usual.

Upon receipt of the survey information, the data was verified, coded, and keypunched by personnel of the Solid Wastes Program. The coding systems and the manner in which the data were transferred onto standard punched cards was described in detail so that the participating States could do their own data processing and analysis if desired.[60]

Data processing by a Honeywell-400 series computer then produced tabulated computer printouts of the information in a format designed to facilitate rapid examination of the raw data. Copies of the printouts (plus punched cards) were returned to the States so that errors in coding or keypunching could be corrected and the data verified.

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[60] Coding manual; the national survey of solid wastes practices. Cincinnati, Solid Wastes Program, September 1967. 63 p.

Data Presentation. The information available from the National Survey on July 1, 1968, has been presented in its basic form. But since the raw data is voluminous and requires basic statistical reduction to summarize it in usable form, a preliminary data analysis was made by computer.[61]

Conclusion. The value of the National Survey conducted in 1968 is beyond question: for the first time, the significant data has been assembled, and it is now possible to begin to plan for future solid waste management programs at the national level, as well as at the regional and local levels, with some assurance that the plans made will correspond with the situation that exists. The dimensions of the solid waste disposal problem, now that they can be estimated, are perhaps even greater than was realized by Congress at the time of passing the Solid Waste Disposal Act of 1965. But if the National Survey of 1968 has presented us with an almost frighteningly clear picture of the problems that now exist, it has also provided us with the first and most indispensable tool for dealing with those problems: the 1968 Survey of Community Solid Waste Practices itself.

Technical Assistance. Over 80 percent of the existing solid waste management systems in the United States are considered to be unacceptable. This can be attributed to many factors such as lack of adequate planning, manpower, and budget; a lack of the application of sound management principles; and nonutilization of acceptable current technology.

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[61] Muhich, et al. Preliminary data analysis.

The application of good technical and management practices to these existing systems to bring about improvements is needed and justified, and is authorized by PL 89-272 [Sec. 202 (b) (2)]. It is reasonable to accept the premise that a national solid waste program with resources and capabilities to draw together all acceptable practices for application of problems can greatly aid in achieving the needed improvements required to assure maximum utilization of the nation's resources while protecting the environment. In fact, only on a national basis can all of the current or emerging new technology available be collected, interpreted, and applied across regional and geographical lines.

The application of technology to specific and real problems at the local operating level can be optimized by the provision of direct assistance in the form of manpower, studies, evaluations, and recommendations. Direct contact with the local technical operations of solid waste management can be our most effective method of achieving improvements, as well as developing a strong public and political awareness of the problems of solid waste management and establishing a base of public support for the programs of the Bureau.

In addition, the technical assistance program of the Bureau serves as a feedback mechanism to the research, development, and demonstration activities of the Bureau in identifying areas requiring new knowledge acquisition, technology developments not published in the literature, systems demonstration, and specific needs of solid waste management systems operations.

The provision of technical assistance by the Bureau began early after the establishment of the Office of Solid Wastes (OSW) in January

1966. Early priorities of the technical services branch of OSW were the establishment of an operating organization, recruitment of staff, and, most important, the initiation of the planning grant program and the National Survey. Thus, the establishment of the technical services branch in Cincinnati in August 1966 was followed by an intense effort to train and orient the staff and to develop capabilities so that the needed direct and indirect assistance activities could be initiated. Historically, the first identifiable direct assistance project was response to a request from the Federal Water Pollution Control Administration and the Corps of Engineers to study and evaluate the potential of pollution from several existing dumps that were to be innundated by a reservoir under construction in Shelbyville, Illinois. Field studies were made and a report with recommendations was submitted to the appropriate agencies. A followup with the Corps indicated that Division recommendations were followed.

Other early identifiable direct assistance efforts were the Bullitt County, Ky., and District of Columbia incinerator studies.[62] The incinerator study was a highly significant step forward in the maturation of DTO. It represented the Division's first entry into a rather controversial area and was also one of the first times that personnel from different portions of the Bureau participated in a joint study.

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[62]Report on the municipal solid wastes incinerator system of the District of Columbia. Cincinnati, U.S. Public Health Service, June 1967. 77 p. Reprinted 1967, 1968.

The growth of the Division has broadened its capabilities to provide assistance authorized by the Act. Today, the Division has a capability in most areas of solid waste management. Intramural projects, besides collecting and disseminating badly needed data, are also improving the capability of the Division to provide assistance.

A review and analysis of the Division's technical assistance activities will provide some insight into the nature and characteristics of solid waste management problems nationally, and the areas requiring Bureau and Division attention. Although recordkeeping on assistance did not really begin until FY 1968, and the combining of the former technical services and systems and operations planning activities in 1969 limits the data available to DTO, it is able to provide an interesting analysis of its activities and subsequently the Bureau's interests.

Since FY 1968, the Division has experienced a 100 percent annual growth of requests for assistance. In FY 1968, 280 requests were received; in FY 1969, 620 requests. During the first quarter of FY 1970, 151 requests were received. Projections for FY 1970 are to receive and respond to 750 requests.

Approximately 10 percent of requests required travel by Division staff, while the remaining 90 percent were handled by correspondence and telephone. Of the direct assistance manpower expended, 45 percent (approximately 10.7 man-years) was utilized to support the 10 percent of the requests that required travel.

It is interesting to note the distribution of request sources as related to the type of solid wastes. Sixty-nine percent of the requests

crossed several waste types, which could be expected as a greater number of the receptors were not specific-waste category oriented and were concerned with two or more waste types. The other two significant groups of requests (11 percent each) are related to the management problems of residential and industrial solid wastes. Eighty percent of Division manpower (approximately 18 man-years) was utilized to support those requests that were concerned with two or more waste types.

The Division has also analyzed the source of requests as they related to the various unit process operations of solid waste management. As in the waste type source, the greatest percentage (40 percent) was of a general nature which cross the lines of two or more of the solid waste management unit operations. As might be expected, the other two major distributions of requests were related to the problems associated with incineration and disposal of solid waste on the land; these percentages were 20 percent and 17 percent respectively. Eight-five percent of direct assistance manpower was expended to support the above three categories of requests.

The Division also analyzed the type of professional resources utilized to respond to the requests. Sixty-five percent of requests were engineering-oriented, 20 percent required data development resources, and 7 percent required the legislative and systems control resources of the Division. It should be pointed out that the direct assistance resource allocation for statistical services computer technology and planning is not necessarily a true indication of the amount of statistical services provided in these areas. A great deal of its

capabilities here are utilized to support other assistance activities and therefore provide a very essential part of the Divison's responsiveness to the receptors.

Engineering. Many solid waste management systems in the country are inadequate and unacceptable. Often communities and industry are not aware of the problems related to inadequate solid waste management or methods of correcting the problems.

Technical assistance is provided in many ways as the various subprojects to be discussed will illustrate. However, the most obvious form of assistance that can be provided at this time is in engineering through the application of existing technology to improve existing conditions. This is accomplished by the provision of available information, discussion of specific problems, and conduct of studies on various systems.

During the first half of FY 1970 the Division responded to almost 200 requests for engineering technical assistance. A simple analysis shows that the nature of these requests is quite similar to that presented previously, but with a slightly greater emphasis on incineration, land disposal, and collection.

An example of engineering assistance by the provision of available information is that provided to the National Air Pollution Control Administration (NAPCA) on their contract work to study and evaluate certain factors of incineration that require a good knowledge of the composition of municipal wastes to be burned. NAPCA could not provide the contractor with this information. On request, the Bureau's Division

of Technical Operations compiled and provided information on composition from over 20 studies conducted by the Division and obtained through the Bureau's grant mechanisms. Following this, assistance was given in interpreting and analyzing these data.

Examples of more extensive efforts requiring field studies follow.

Study of Recreation Solid Wastes for the U.S. Department of Agriculture--Forest Service. The Forest Service, U.S. Department of Agriculture, requested that the Bureau of Solid Waste Management conduct a study of National Forest recreation areas. The study was to establish waste generation rates for major recreation activities and to determine the cost of solid waste handling for selected Forest Service districts.

Following a series of preliminary meetings between Bureau and Forest Service personnel and a February 1968 trial study at the Ocala National Forest, Florida, the Forest Service submitted a list of 16 sites for study. During the summer of 1968, two study teams, each containing two Bureau engineers and two Forest Service personnel, studied solid waste composition and generation in 11 National Forests. An additional study of two winter recreation areas was made by the Forest Service. A report of the findings of the study has been prepared and has been published.[63]

This study provides the most comprehensive information on solid waste management in recreational areas that has been published since

[63]Spooner, C. S. Solid waste management in recreational forest areas. Public Health Service Publication No. 1991. Washington, U.S. Government Printing Office, 1971. 96 p.

1955. The Forest Service anticipates being able to make substantial improvements in their storage, collection, and disposal operations based on recommendations contained in this report. Also, substantial economic improvements are possible by applying the equations developed for optimizing the management systems. It is anticipated that many other agencies at the Federal, State, and local levels will also be able to use this information in planning new recreational facility needs or improving operations at those already in existence.

River Rouge, Michigan, Collection System Study. The Mayor of River Rouge, Michigan, requested assistance from the Bureau in his efforts to improve the solid waste collection system of his city. Examples of conditions that needed correction included the use of 55-gallon drums for storage, irregular and excessive collection schedules that included residential service from two to five times per week, and the use of inappropriate and antiquated collection vehicles. It was determined that assistance could be provided and, at the same time, valuable data could be gathered for our own use in studies of collection systems.

A one-week field study was conducted during November 1969, applying techniques developed for the Satellite Vehicle Collection System Study (Scooter Study).[64] In addition, the system was analyzed from the standpoint of optimizing storage-container and collection-truck

[64]Perkins, R. A. Satellite vehicle systems for solid waste collection; evaluation and application. Washington, U.S. Environmental Protection Agency, 1971. (To be distributed by National Technical Information Service, Springfield, Va.) See also, Delaney, J. E. Satellite vehicle waste collection systems; summary report. Washington, U.S. Government Printing Office, 1971. (In press.)

selection, number of crews required and crew size, type of service rendered (i.e., backyard, curbside, alley, etc.), and routing.

The report is in press, but already the city has reduced its number of collection crews from six to five and is making definite efforts to obtain appropriate storage containers and collection vehicles, and to improve collection routes.

Planning. As specified under the Solid Waste Disposal Act (P.L. 89-272, Title II, Sections 205 and 206), the Bureau is committed to fostering comprehensive Statewide and interstate programs and planning for the disposal of solid waste. This includes the coordination of solid waste management systems with those for air and water pollution control and other related State, interstate, regional and local planning activities. To aid in completion of plans sufficient to guide States and interstates, the Bureau provides technical assistance in professional planning to apply methods and techniques of planning, management, finance, and public administration.

Because of shortage of personnel in solid waste agencies having the necessary background to develop a solid waste management plan in its entirety, the Bureau developed a technical assistance project for providing consultation in the methodologies of planning in order to increase the likelihood that adequate plans will be completed.

In view of the Bureau's commitment, the Planning Section, Division of Technical Operations, provides on-site consultation in the methodologies of planning and coordination with other agencies and plans.

Specifically, assistance is provided in planning process system installation and plan formulation, data analysis, development of program

objectives, and the definition of and encouragement for adopting modern management techniques needed to plan, organize, coordinate, direct, control, and evaluate results of solid waste management systems. Guidelines (developed under project TO 14.1/0) are used as a consultation tool in this project.

Since this project began, 37 States, 3 interstate agencies, and 1 territory have been provided on-site planning consultation on at least one occasion. Two or more consultation meetings have been conducted in 24 States.

Also, a National Symposium of State and Interstate Solid Waste Planning Agencies was held, at which general topics and workshops provided information and discussion about the planning process and data needs, legislation, intergovernmental and public relations, and plan implementation to over 150 attendees. The meetings included a solid waste management panel session for the 1969 National Planning Conference of the American Society of Planning Officials. This panel was organized to guide local, regional, and State planning professionals and officials toward solid waste planning within their jurisdictions. Over 100 persons attended this session.[65]

Management Sciences. Data on current economics as well as assistance in the application of management techniques are valuable aids at the

[65]Gluckman, L. A., ed. Planning for solid waste management; symposium of state and interstate solid waste planning agencies, St. Louis, September 9-11, 1969. Public Health Service Publication No. 2093. Washington, U.S. Government Printing Office. (In Press.)

local level. In fact, technical assitance can take two main forms: assistance in evaluating new technology, and assistance in optimizing presently-used techniques. In both cases, management sciences techniques play a significant role.

The Program Evaluation and Review Technique (PERT) was applied to the San Diego demonstration project. A report was prepared and submitted outlining the procedures to be used.

Management sciences technical assistance has been provided to many on-going projects funded by the Bureau of Solid Waste Management. Division personnel have provided assistance to the project at Wichita Falls, Texas, relating to simulation of network and routing problems. Assistance on the Raleigh, North Carolina, demonstration grants has centered around a close monitoring and constructive criticism of work relating to the project. Intensive review and advice have been rendered on many demonstration grant reports. Also, assistance in locating disposal sites using the fixed charge algorithm was supplied to the Tocks Island Regional Advisory Council.

In the area of economics, the Division has developed a strong capability for technical assistance. Cost accounting systems have been developed and are either implemented or will soon be installed in: Kansas City, Missouri; Chilton County, Alabama; Helena, Montana; Guam, Department of Public Works; Northwest Georgia Regional Health Advisory Council Inc.; Southern West Virginia Regional Health Council Inc.; New Orleans, Louisiana; Ogden, Utah; Dayton, Ohio. The Charles County Community College in La Plata, Maryland, will use these systems

in their courses on waste management. Accounting and PERT systems for the Bureau's publishing and clearance operations office have been designed and installed.

In the economic assessment area, assistance has been rendered in composting and incineration. A comprehensive report on the costs of composting was developed for the Johnson City, Tennessee, and Gainesville, Florida, composting plants. This information is being utilized to assess the future of composting technology.

Division personnel have participated in training lectures and seminars. A constant attempt has been made to disseminate information through formal presentation at professional meetings. Members of the Management Sciences Section also participated actively in Model City State Planning activities, and a NACO conference on solid waste management.

Computer Technology. The Bureau of Solid Waste Management is committed to the collection, preparation, and dissemination of data useful for determining the feasibility of improved solid waste techniques and for responding to requests for scientific and technical information. This data and the relationships that can be shown from it are a necessary base in providing assistance to State and local governments, other Federal agencies, and industry to improve their capabilities to meet the solid waste management problems of the Nation. Since this encompasses a national effort to provide the service, tremendous amounts of data are gathered. Linked with the need for timeliness of the information, the need to know now, this effort would

be greatly hampered by use of manual procedures. Effective management depends heavily on information, its availability, accuracy, and content. It is imperative that modern, up-to-date techniques of electronic data processing be fully exploited. The complexities of both computer science and solid waste management make a strong in-house data processing capability essential.

Computer programs are developed which provide the Bureau with the capability for attacking the Nation's solid waste problem on two fronts: (1) by providing direct assistance to operating personnel, be they State agencies, consultants, or industry, in the form of timely relevant information; (2) by providing the Bureau with an increased capability in preparing for the distribution of relevant knowledge on solid waste management.

Specific technical assistance aspects of this activity are to develop, test, and implement scientific and statistical computational systems for use on the IBM 1130 and Honeywell 400 computers. Another objective is to provide programming support in the area of computer sciences and related fields, including systems analysis and data presentation. Although the development of computational systems is machine-dependent and oriented toward the activities of the Bureau, the outputs from such systems, namely tabulations and summaries, directly assist State and local governments and industry in improving their capabilities to meet the Nation's solid waste problems.

Statistics. Statisticians familiar with the field of solid waste management are a scarce resource. In fact, Bureau participation with

other public or private agencies or groups has indicated that statistical assistance is not readily available. The Bureau is committed to a great data collection effort. Innovations are being studied. Predictive abilities are being developed. The success or failure of these efforts depends in part on their statistical validity. The need for a strong statistical resource is, therefore, evident.

This technical assistance activity makes readily available to the Bureau statistical competence familiar with the subject matter of solid waste management. Statistical services are provided both in-house projects and for the Bureau's activities with other public or private agencies or groups. Such services include regression analysis, design of sample surveys, design and analysis of experiments, evaluation and analysis of data from field studies, prediction and forecasting, and estimation.

Models have been developed to predict costs of collection systems, incinerator costs, amount of solid waste per residential dwelling, solid waste generated by commercial establishments, productive time for satellite collection vehicles, and productive time for conventional equipment.

As a follow-up to the National Survey of Solid Waste Practices, the Basic Data Branch of DTO is developing forms and procedures for a survey of industry and agriculture. Suggestions have been given on the design and implementation of that survey. Finally, the Bureau, through contractors, is interested in information about industrial solid waste, both quantitative and qualitative. Most contractors are proceeding on a

sampling basis. Many, however, needed assistance in setting up the necessary statistical procedures. In addition, the Bureau is interested in models for predicting industrial solid waste quantities. Again, contractors have needed assistance in this endeavor.

Data Development. The general unacceptability of solid waste management systems in the United States can be attributed to many factors, one of which is the lack of readily available quantitative and qualitative information and data which is essential for the proper design and operation of systems.

The Basic Data Branch has the primary responsibility of providing assistance in the form of basic data and information about all aspects of solid waste management which can aid communities and agencies to plan, design, and operate acceptable solid waste management systems. The level of effort of assistance varies from merely providing existing information and data, to comprehensive literature searches to obtain the information, to the development of the necessary information and data through field studies and investigations and contracts. During FY 1969, the Basic Data Branch responded to 135 requests with five requiring field investigations. In addition, DTO is conducting a series of contract studies to collect basic data in some of the most deficient areas. The contracts are described in the current edition of Public Health Service Publication No. 1897.

Legislation. Legal assistance and advice is provided, on request, to States, municipalities, private businesses, and individuals regarding solid waste legislation and rules and regulations relating to its control.

Such requests for assistance include copies of existing ordinances, bills, and statutes or a review of a draft at either level. The Bureau, in complying with the request, can guide the recipient into channels which will encourage the development of either a State act or local ordinance along comprehensive waste management lines. Solid waste management acts and rules and regulations, submitted by Bureau Regional Representatives, are reviewed with recommendations being returned to be forwarded to the requestor.

Several requests have been received for local ordinances, such as one received by Region II from a Councilman of the Township of Parsippany, Troy Hills, New Jersey. His request, and others, have been met by supplying a package of ordinances assembled by DTO.

The Region III Federal Solid Waste Management Representative had a request from a Professor of Engineering, University of West Virginia, a member of the service committee to the advisory committee to the State legislative body, for representative acts to be used in the drafting of a State solid waste disposal act.

A law firm in New York City asked for and was provided bills and enacted legislation in the waste disposal field.

A proposed New York Health Code was submitted for the Acting Director, Bureau of Sanitary Engineering, Department of Health, City of New York. Proposed solid waste disposal acts for Georgia and Tennessee were reviewed at the Regional Representative's request. The DTO Guidelines Section assisted in these.

A very detailed project was initiated by the National Solid Wastes Management Association in a request to develop a model contract for the

operation of a sanitary landfill. This has been completed and will include work by the Planning, Guidelines, and Management Sciences Sections. The same source has forwarded a draft for a model collection contract which will be published under joint authorship by the Bureau.

ACTIVITIES IN SOLID WASTE MANAGEMENT, 1966-1970 (cont'd.)

Training Operations

The establishment of a Solid Wastes Training Activity was also authorized by the Act. The purpose of this activity is to alleviate the shortage of trained technical and nontechnical personnel in the solid waste management field, The effect has been organized along two basic lines: training grants to institutions of higher education, and an in-house training program.[66]

Training Grants are awarded to colleges and universities to establish and expand graduate programs in solid waste technology and management. In the past, few graduate-school candidates in the environmental health disciplines elected to do graduate work in the solid waste field because of the tendency of the engineering profession as well as public officials to give the solid waste programs low priorities. The financial help provided by the Bureau of Solid Waste Management training grants will help to relieve the critical shortage of technical personnel in the field. Through FY 1968, a total of $943,000 had been awarded by the U.S. Public Health Service for solid waste training to the following universities: Drexel Institute of Technology,

[66]Lefke. Summaries of solid waste research and training grants.

University of Florida, Georgia Institute of Technology, University of Kansas, University of Michigan, Rensselaer Polytechnic Institute, University of Texas, University of West Virginia, University of Houston, and the University of Illinois.

The training in solid waste management directly performed by the Federal Government has been conducted by the Solid Waste Training Operation, Office of Training and Manpower Development, Environmental Control Administration. This effort is directed principally toward the presentation of a series of regularly scheduled courses, generally a week in duration, at the Training Institute's facilities in Cincinnati or at other locations throughout the United States. Courses with equivalent content are not generally presented elsewhere by either public or private agencies. Course content emphasizes current practices acceptable from both the public health and economic viewpoints. The material is revised and updated as necessary for each presentation. Professional personnel with solid waste management responsibilities from manufacturers of equipment, consulting engineering firms, Federal, State and local health agencies, Armed Forces personnel, public works officials, and operators of private refuse handling operations, are typical of the participants attending the regularly scheduled courses.

Courses Offered. The staff in solid waste training was assembled in the summer of 1966. Prior to that time, training courses were conducted with considerable dependence on guest lecturers.

The training operations staff and funding was transferred to the training program of the National Center for Urban and Industrial Health when the Solid Wastes Program was made a part of the latter organization.

The staff remained intact and continued to serve the training needs of the Bureau of Solid Waste Management, while having available the facilities of the Environmental Control Administration.

The Elements of Solid Waste Management course was given early emphasis. As a general presentation of solid waste problems and handling practices, it was, and remains, the basic course in solid waste management. It is presented more often than any other course and continues to be heavily subscribed. More specialized offerings in sanitary landfill principles, principles of incineration, composting methods, health and safety in solid waste handling, solid waste handling--field evaluation, and solid waste operations management followed quickly. A solid waste orientation course (No. 650) was created to draw the attention of elected and public works officials to the dimensions of the solid waste problem and to the developing State and Federal solid waste programs. The need for this course is now largely ended and others are taking its place.

In the future courses will be increasingly offered in the field; more time will be given to assisting in the training of solid waste handling personnel at the foremen level, at sanitary landfill and incinerator locations, where the opportunity and demand develop. Participation in university-sponsored seminars on solid waste training activities has become more prevalent, and requests for this assistance are on the increase. A visual aid library was established, which includes many slides depicting various aspects of solid waste disposal. Examples of the courses offered by the solid waste training section are listed below.

Elements of Solid Waste Management. This one-week course includes broad coverage of the technical aspects and new developments in the field

of solid waste management. Lectures, field trips, and classroom demonstration are supplemented with homework problems.

Sanitary Landfill--Principles. The methodology of sanitary landfill operation and the basic considerations necessary for planning a sanitary landfill are presented in the sanitary landfill course. Other topics covered include an understanding of the many public health, aesthetic, and economic advantages that a sanitary landfill offers in comparison with an open dump; the steps necessary in dump closing or conversion to sanitary landfill; and the equipment and auxiliary facilities needed to operate a sanitary landfill properly.

Principles of Incineration. The factors necessary to evaluate and design municipal incinerators are presented. State and local public health engineers and sanitarians concerned with incinerators find this course particularly valuable.

Composting Methods. The principles of design, fundamentals of operations, and future potential for composting operations in the United States are presented. The course is of particular interest to professional engineers and sanitarians engaged in the evaluation and design of composting facilities.

Solid Waste Operations Management. A field course is offered that emphasizes particular operations with the required local requirements and criteria.

In the first year of direct training operations, two courses were presented with a federal effort of 645 man-days to 129 trainees; by fiscal year 1970, there were approximately seven times as many course presentations (Table 5).

TABLE 5

SOLID WASTE MANAGEMENT TRAINING OPERATIONS
(Fiscal Years 1966-70)

	Number of courses presented	Number of trainees	Number of man-days
FY 1966	2	129	645
FY 1967	7	378	990
FY 1968	13	691	2,107
FY 1969	13	451	1,790
FY 1970	14	659	2,189
Totals	49	2,308	7,721

Training Grants. For a complete description of training grants, including funding, see the current edition of Public Health Service No. 1596. The following descriptions illustrate the diversity of training grants awarded in recent years.

Drexel Institute of Technology, Philadelphia, Pennsylvania. Under this grant a training program was initiated in solid waste management at the master's-degree level. The studies are established as a specialized curriculum within the environmental engineering and science program. The emphasis is on solid wastes with graduates trained in community solid waste management and for administration of State and Federal solid waste programs. Depending upon the electives selected and prior education, students are candidates for degrees in environmental engineering, civil

engineering, and science. The curriculum provides courses in environmental health design and operation of collection and disposal systems, as well as in general engineering, planning, administration, and management. Besides the interdisciplinary approach at the Institute, a close working relationship exists between the Institute and State and local governments.

Georgia Institute of Technology, Atlanta, Georgia. Under this grant, a specialized interdisciplinary training program in solid waste technology was begun at the master's-degree level. The program is administered by an interdisciplinary committee, principally from the School of Civil Engineering (Sanitary) and the School of Industrial Engineering. The program is oriented toward the education of engineers in the unit processes utilized in disposal, systems analysis, and the optimization of collection systems, as well as the economic and administrative aspects of solid wastes management. Students take a core curriculum in solid wastes technology and related disciplines, and attend seminars and special workshops. Major emphasis is on civil, sanitary, industrial, chemical, and mechanical engineering.

University of Michigan, Ann Arbor, Michigan. This grant supports an expanded teaching program in solid wastes at the master's level. It is an interdisciplinary approach developed around the Civil Engineering Department and involving related fields such as environmental health, urban and regional planning, and public administration. The curriculum emphasizes the environmental engineering aspects of the solid waste management problem. Current courses in the Civil Engineering

Department serve as a core of the curriculum for the solid wastes program. The program is designed to train personnel in presenting knowledge more effectively about the solid waste problem and to develop new knowledge and methods in this field.

University of Texas, Austin, Texas. This grant was designed to initiate an instructional and research program in the disposal aspect of solid wastes at the master's level. Training is offered as a specialty within the existing environmental health engineering program, in cooperation with the Department of Chemical Engineering. Objectives include the training of graduate students, the development of a competent health-related teaching and research training program, and the opportunity for both faculty and students to study new approaches to the disposal of solid wastes. Students specializing in solid waste management take specific courses amounting to at least half the hours required for the master's degree. Their training is directed toward solving problems of municipal refuse disposal. Research efforts are directed toward solid waste disposal problems.

University of Florida, Gainesville, Florida. Support of this program is planned to begin master's-level training that emphasizes solid wastes in a newly formed Department of Environmental Engineering. The program provides training of personnel for design and operation of solid waste disposal facilities and training of research personnel for the development of basic data needed to design effective waste disposal systems. Students specializing in solid wastes take specific courses amounting to about half the hours required for the master's degree. As the program

develops, a systems analysis approach will be included. An interdisciplinary, all-university committee coordinates research and training in solid waste management. Initially this program included studies in chemical and environmental engineering, and aspects of botany and soils.

West Virginia University, Morgantown, West Virginia. Support of this program is designed to expand master's level teaching that emphasizes solid waste management. To enlarge this program, research in broad areas on the economic, and engineering aspects of municipal refuse handling, land reclamation, and related special problems is encouraged.[67]

Students specializing in solid waste management take specific core courses amounting to at least half the hours required for the master's degree. Qualified nonengineering graduates may enter the environmental engineering program on an open enrollment plan. The solid waste management training program is mutually supporting with graduate programs in air pollution control engineering and water supply and waste treatment. This interrelationship provides the student with the opportunity to participate in an active, broad-scope environmental engineering program. The graduate solid waste management education and research at West Virginia University has an interdisciplinary approach: specialists in sanitary engineering and preventative medicine exchange

[67]MacQueen, A. A., Jr., and R. Zaltzman. Regulation of solid wastes by public law in West Virginia. [Cincinnati], U.S. Department of Health, Education, and Welfare, 1970. 29 p. [Restricted distribution.]

lectures, the Bacteriology and Civil Engineering Departments administer a joint research project on sanitary landfills, and the Chemistry and Sanitary Engineering Departments contribute to a joint laboratory effort.

Rensselaer Polytechnic Institute, Troy, New York. This program is designed to provide training in supervision, planning, and administration of solid waste disposal facilities, at the master's level. Emphasis on solid waste includes consideration of collection, transportation systems, and disposal. The emphasis is directed to courses enabling a broad understanding of the management of solid waste and its relation to health problems. The New York State Department of Health is cooperating with the Rensselaer Institute faculty.

The program, originating in the Division of Bio-Environmental Engineering, includes engineering, scientific, and economic aspects. It is strongly supported by an interdisciplinary committee consisting of the departments of biology, chemistry, science, and engineering.

University of Kansas, Lawrence, Kansas. Support of this program is designed to expand master's level and to initiate doctoral level training, emphasizing solid wastes. The program is within the environmental health engineering and environmental health sciences curriculum. Its objective is to educate young engineers in the techniques of solving practical problems of solid wastes through research. The interdisciplinary approach is obtained through the participation of the mechanical, industrial, and chemical engineering departments and other fields such as political science, business administration, and economics.

The master's-level graduates are trained for effective careers in State health departments, Federal agencies, engineering companies,

and industrial organizations. The doctoral graduates are oriented towards an academic career involving teaching and research in solid waste problems. Both the MS- and PhD-level programs emphasize research as a learning experience.

ACTIVITIES IN SOLID WASTE MANAGEMENT, 1966-1970 (cont'd.)

Information Activities

Before the December 1968 reorganization of the Solid Wastes Program, activities concerned with the preparation and dissemination of information were housed organizationally within various components of the program. Upon the reorganization of the program into the Bureau of Solid Waste Management, certain of those activities that could appropriately be centralized were regrouped to form a new unit, the Office of Information, composed of three basic segments: the Publishing Operations Office, the Public Information Office, and the Solid Waste Information Retrieval System (SWIRS).

Publishing Operations Office. Bureau manuscripts are published as government pamphlets, brochures, and books, or as articles appearing in professional, scientific, and technical journals.[68] Bureau manuscripts report and interpret a variety of technical subjects designed for seven--or varying combinations of the seven--different audiences on several continents. These audiences may be mainly characterized as professional personnel

[68]Bayless, T. B., comp. Publications of the Federal solid waste management program, 1951-1970. Washington, U.S. Government Printing Office. (In press.)

working in the engineering, physical, social, or management sciences, those working in solid waste management, those working in local or State government, and the general public. Bureau publications must appeal in style, conform to the conventions and preferences of the various audiences, and communicate purposefully and with technical accuracy to each intended audience within the scope of established Bureau policy and goals.[69]

The function of the Publishing Operations Office is to process through editing, revision, clearance, printing, and distribution all manuscripts reporting on work of the Bureau, authored by members, contractors, or grantees of the Bureau. This results in printed publications that carefully and accurately represent the varied efforts of the Bureau in carrying out the intent of the Solid Waste Disposal Act. The Publishing Operations Office actively encourages and develops authorship of a wide spectrum of publications, initiating manuscripts when necessary. In addition to editing and publishing the work of the Bureau, the Publishing operation distributes these publications on various mailing keys and sends out single issues on request. From Fiscal Year 1969 through Fiscal Year 1970, the Bureau had processed more than 450 manuscripts and had published more than 200 titles in publications varying from a few to several hundred pages in length. During the same period, more than 289,627 copies of solid waste management publications were distributed.[70]

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[69]Curry, M. G., A. Hamilton, and C. S. Lawson. Mechanics of style; a guide for Bureau of Solid Waste Management authors, secretaries, and contractors. [Cincinnati], U.S. Department of Health, Education, and Welfare, 1969. 26 p.

[70]Bayless, T. B., E. H. Cox, M. S. Hackett, and B. A. Johnson. Solid waste management: a list of available literature. [Cincinnati], U.S. Department of Health, Education, and Welfare, Sept. 1970. 15 p.

Public Information Office. The principal responsibilities of this office are as follows:

1. Responding to public inquiries received by letters and by personal visits of individuals or groups. These requests come from such varied sources as the lay public, students, and professionals in technical fields, and political officials.

2. Preparing and disseminating news releases to report all significant activities of the Bureau, including work performed by means of grants, contracts, and in-house research.

3. Preparing speeches for the Bureau Director and other senior staff members.

4. Preparing in whole or in part, magazine articles on Bureau activities, or supplying information and cooperating with free-lance writers and media representatives in the production of articles.

5. Handling publicity arrangements for Bureau-sponsored conferences, meetings, and other special projects.

Solid Waste Information Retrieval System

SWIRS is a keyword-oriented system whose basic objective is to collect, abstract, index, and catalog, the world-wide solid waste literature for Bureau staff, contractors, grantees, solid waste researchers, and Congressional offices, with limited service to the general public. Specific activities include:

1. Reviewing the open technical and scientific literature for material relevant to solid waste management and related fields.

2. Securing published patents related to solid waste technology, advising the Bureau staff of their existence, and preparing a patent abstract bulletin.[71]

[71] Connolly, J. A., ed. Abstracts; selected patents on refuse handling facilities for buildings. Public Health Service Publication No. 1793. Washington, U.S. Government Printing Office, 1968. [320 p.]

3. Continuing the annual annotated bibliography series covering the solid waste field.[72-79]

4. Providing routine literature searches, reference abstracting, and bibliographic citations upon request.

5. Preparing a monthly bulletin of recent accessions to the retrieval system, which is distributed by the Bureau to the public.[80]

6. Maintaining comprehensive Bureau grant and contract files as separate system.

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[72]Van Derwerker, R. J., and L. Weaver. Refuse collection and disposal; a bibliography, 1941-1950. Public Health Service Publication No. 91. Washington, Federal Security Agency, 1951. 90 p.

[73]Division of Sanitary Engineering Services. Refuse collection and disposal; a bibliography, 1951-1953. Public Health Service Publication No. 402. Washington, U.S. Department of Health, Education, and Welfare, 1953. 39 p. Suppl. A.

[74]Weaver, L. Refuse collection and disposal; an annotated bibliography, 1954-1955. Public Health Service Publication No. 91. Washington, U.S. Government Printing Office, 1956. 48 p. Suppl. B.

[75]Williams, E. R. Refuse collection and disposal; an annotated bibliography, 1956-1957. Public Health Service Publication No. 91. Washington, U.S. Government Printing Office, 1958. 48 p. Suppl. C.

[76]Williams, E. R., and R. J. Black. Refuse collection and disposal; an annotated bibliography, 1958-1959. Public Health Service Publication No. 91. Washington, U.S. Government Printing Office, 1961. 73 p. Suppl. D.

[77]Black, R. J., and P. L. Davis. Refuse collection and disposal; an annotated bibliography, 1960-1961. Public Health Service Publication No. 91. Washington, U.S. Government Printing Office, 1963. Revised 1966. 69 p. Suppl. E.

[78]Black, R. J., J. B. Wheeler, and W. G. Henderson. Refuse collection and disposal; an annotated bibliography, 1962-1963. Public Health Service Publication No. 91. Washington, U.S. Government Printing Office, 1966. 134 p. Suppl. F.

[79][The Franklin Institute.] Solid waste management; abstracts from the literature, 1964. Washington, U.S. Environmental Protection Agency, 1971. (In press.)

[80][The Franklin Institute.] Solid Waste Information Retrieval System Accession Bulletin. [Monthly serial.] Washington, U.S. Environmental Protection Agency, 1970.

7. Screening acquisitions of approximately 2,000 clippings per month from a news clipping service for current interest to Bureau personnel as well as supplementing technical information requests on the subject matter.

8. Maintaining a library with holdings of approximately 1,200 documents, 95 percent of which are in the field of solid waste management.

9. Maintaining a usable-quote file and an equipment file on solid waste management equipment.

To fulfill the first-mentioned part of its mission, SWIRS developed a contract for a literature search and abstracting service, which was awarded to the Franklin Institute of the State of Pennyslvania in June 1967. The contract called for the (then) Solid Wastes Program to receive 300 abstracts and copies of articles per month starting July 5, 1967. By July 1, 1968, 2,600 abstracts and documents were on file in the systems. SWIRS staff members continued monitoring the contract activity and abstracting much of the nonperiodical literature. As of July 1, 1969, there were 4,250 abstracts and documents in the system, representing both in-house and contract efforts, and by July 1, 1970, there were 6,950 holdings. Tentative plans were underway at the latter date to computerize the search aspect that will include insertion of all keywords and accession numbers into a computer bank. This will reduce the lag time in responding to requests. Tentative plans are to open SWIRS to the public approximately six months after the total conversion to the computerized base. Tentative user projections are for approximately 1,100 to 1,200 requests to be processed through the system in the first year of operation. This will, of course, increase as the solid waste information retrieval system becomes known in the field of solid waste management.

IV

FUTURE NEEDS AND PROGRAMS

In view of impending changes, this report may well conclude any description of progress in solid waste activities within the U.S. Department of Health, Education, and Welfare. On July 9, 1970, the President sent to Congress a proposal that, if accepted, will place the Bureau of Solid Waste Management in a newly established organization, the U.S. Environmental Protection Agency (EPA).

Five months earlier, in the President's message to Congress on the environment, he announced his intention to recommend needed reforms, which would involve major reassignments of responsibilities among Departments. In speaking of the need to improve environmental quality, he said, "The tasks that need doing require money, resolve and ingenuity--and they are too big to be done by government alone. They call for fundamentally new philosophies of land, air, and water use, for stricter regulation, for expanded government action, for greater citizen involvement, and for new programs to ensure that government, industry, and individuals all are called on to do their share of the job and to pay their share of the cost."

According to the later White House statement, "The mission of the EPA will be to organize the fight against environmental pollution on an integrated basis which acknowledges the critical relationships between pollutants, forms of pollution, and control techniques . . . . (The present)

fragmentation of effort has resulted in confusion and overlap, some delay in the recognition of new problems, and the continuance of inefficient management techniques. It has effectively inhibited any comprehensive examination of the total effects of pollutants by man, plants, animals and ecological systems."

Although much has been accomplished since passage of the 1965 Solid Waste Disposal Act, the Bureau has long felt the severe constraints imposed by budget and personnel limitations, as it has been in the position of competing for limited resources with widely disparate programs of the Department of Health, Education, and Welfare. In an effort to make the most of inadequate resources, the Bureau has had to allocate much of its time and money to "putting out fires"--to the refinement of proven techniques with immediate application--and has devoted less time than it would wish to the exploration of new or undeveloped concepts, such as recycling and reuse, which are the key to ultimate solution of solid waste management problems. The Bureau anticipates that placement in the U.S. Environmental Protection Agency will provide a stability that has been lacking heretofore, and that with increased visibility, the tools it requires to do the most effective job will necessarily follow.

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